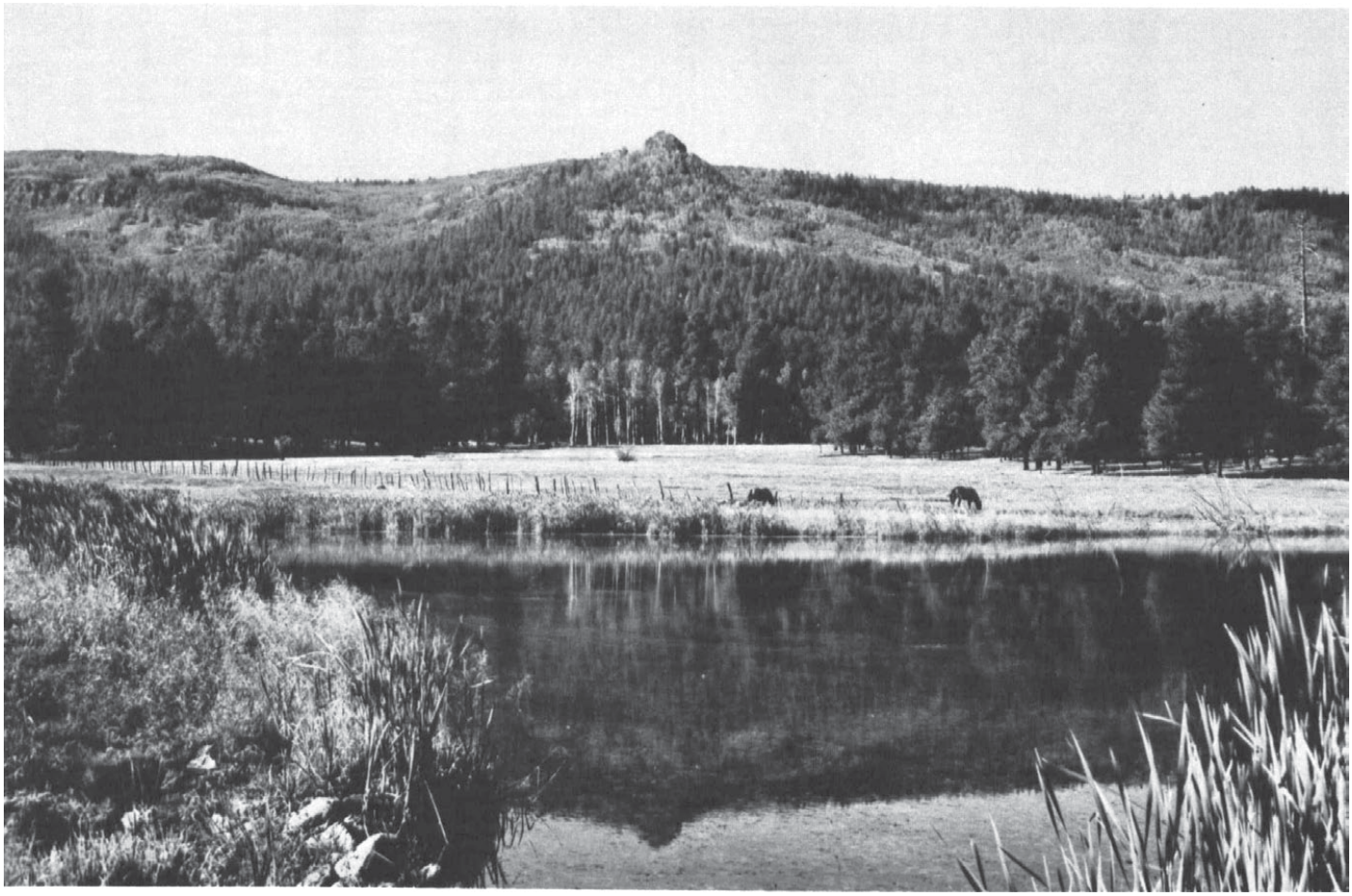
SOIL SURVEY OF

Apache County, Arizona

Central Part



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Arizona Agricultural Experiment Station

Major fieldwork for this soil survey was done in the period 1958–67. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1967. This survey was made cooperatively by the Soil Conservation Service and the University of Arizona Agricultural Experiment Station. It is part of the technical assistance furnished to the Apache Natural Resource Conservation District.

Copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Apache County, Arizona, Central Part, are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the survey area in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit and range site in which the soil has been placed.

Individual colored maps that show the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those that have a moderate limitation can be colored yellow, and those that have a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and the range sites.

Ranchers and others can find, under "Range Management," groupings of the soils according to their suitability for range and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about the formation and classification of soils in the section "How the Soils of Apache County, Central Part, Were Formed and How They Are Classified."

Newcomers in Apache County, Central Part, may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information given in the section "Additional Facts About the Survey Area."

Cover: Landscape in the Bushvalley-Cambern association.

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SOIL SURVEY OF APACHE COUNTY, ARIZONA, CENTRAL PART

BY MACK L. MILLER AND KERMIT LARSEN, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF ARIZONA AGRICULTURAL EXPERIMENT STATION

APACHE COUNTY, CENTRAL PART, consists of that part of Apache County between the Navajo Indian Reservation on the north and the Apache National Forest on the south. It also takes in blocks of land around Alpine, Nutrioso, and Greer, all within the Apache National Forest. This survey area is on the southern edge of the Colorado Plateau in the east-central part of Arizona (fig. 1). It has an area of approximately 2,113,800 acres. Saint Johns, the county seat, is 175 miles northeast of Phoenix and 155 miles west of Albuquerque, New Mexico.

Elevations range from 5,200 feet at the junction of the Little Colorado River and the Navajo County line to an extreme of 9,105 feet near the center of the southern boundary of the survey area. Generally, elevations along the New Mexico State line are more than 6,500 feet, whereas in the rest of the survey area they generally range from about 5,300 to 5,800 feet.

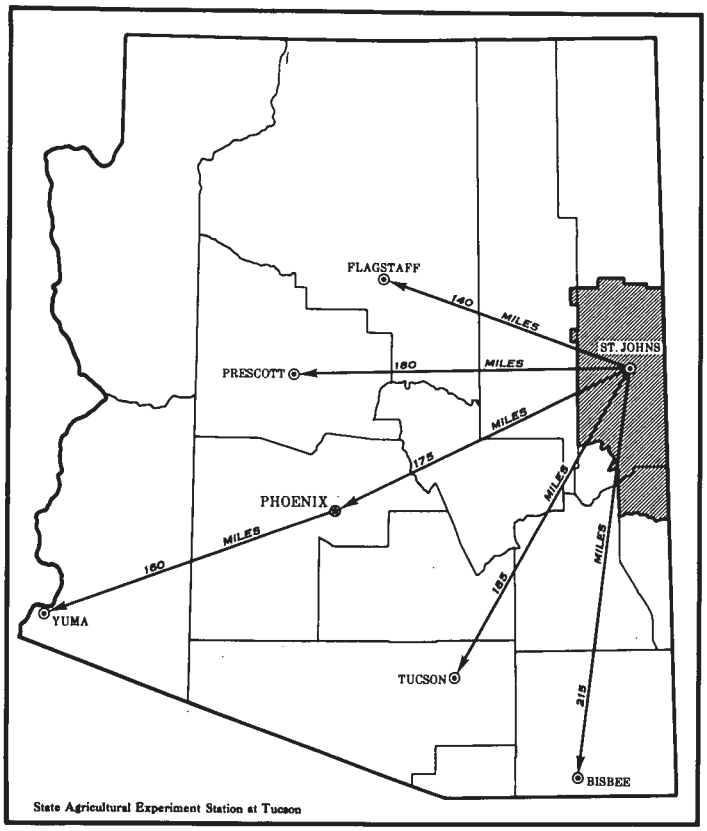

Figure 1.—Location of Apache County, Central Part, in Arizona.

The southern part of Apache County, Central Part, is characterized by irregular topography formed by lava-capped mesas, cinder cones, and deep canyons. This area includes the northern flank of the White Mountains and other parts of them in the vicinity of Alpine, Nutrioso, and Greer. The middle and northwestern parts of the survey area consist of badlands, broad valleys, retreat escarpments, and extensive flat, mesalike highlands whose summits show general accordance and levels of ancient erosion surfaces carved on the underlying soft, sedimentary material. The northeastern part of the survey area, except along the Puerco River, is a broad, relatively flat sandy plain that is generally above an elevation of 6,000 feet.

The climate and precipitation of Apache County, Central Part, vary considerably with elevation. Alpine, in the White Mountains at an elevation of 8,000 feet, has an average annual temperature of 43.4° F. and an average annual precipitation of 20 inches. Springerville, in the southern part of the survey area at an elevation of 6,964 feet, has an average annual temperature of 48.7° and an average annual precipitation of 12.1 inches. Saint Johns, at an elevation of 5,730 feet, has an average annual temperature of 52.4° and an average annual precipitation of 11.4 inches. Petrified Forest National Park, at an elevation of 5,460 feet, has an average annual temperature of 65.6° and an average annual precipitation of 8.7 inches. See the section of this survey entitled "Climate" for more information of this nature.

Ranching and lumber processing are the most important industries. Irrigated farming is practiced along parts of the Little Colorado River. U.S. Highway 66 (Interstate 40) crosses the extreme northern part of the survey area; more than 1 million cars travel this route each year.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Apache County, Central Part, where they are located, and how they can be used. Originally, it was planned as two separate surveys. The first fieldwork was done from 1958 to 1960 and consisted of a soil survey of the cropped areas and adjacent lands, including blocks of

land within the Apache National Forest, in the vicinity of Alpine, Nutrioso, and Greer. This first fieldwork was done on base maps at a scale of 8 inches equals 1 mile. The rest of the field mapping, mostly rangeland, was done from 1961 to 1967 on base maps at a scale of 2 inches equals 1 mile.

The type of soil symbol used on the soil maps at the back of this survey indicates the level of mapping intensity. In the high-intensity survey, a capital and lowercase letter are used in each soil symbol. In the low-intensity survey, both letters in the symbols are capitals.

Soil scientists went into the survey area knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the survey area, they observed the steepness, length, and shape of slopes; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in areas nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and *soil phase* are the categories most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Eagar and Springerville, for example, are the names of two soil series. All the soils in the United States that have the same series name are essentially alike in those characteristics that affect their behavior in the natural, undisturbed landscape.

Soils of one series can differ somewhat in texture of the surface layer and in slope, stoniness, or some other characteristic that affects the use of the soil by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Tours clay loam is one of several phases within the Tours series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries of the individual soils on aerial photographs. These photographs show buildings, drainageways, trees, and other details that greatly help in drawing boundaries accurately. The soil map at the back of this survey was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

On maps that are of smaller scale and less detail, such as part of the ones in this survey, a mapping unit can contain several soil phases or even more than one soil series. On such maps, the soil scientists have the problem of delineating areas where different kinds of soils are so intricately mixed and occur in such small individual tracts that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Jocity-Claysprings complex. Another kind of mapping unit is the soil association. It consists of two or more soils that may differ from each other but are geographically associated in a consistent pattern and proportion too intricate for separate mapping. Clovis-Palma association, undulating, is an example.

In most areas surveyed there are places where the soil material is so rocky, so eroded, so inconsistent, or so frequently worked by wind and water that it scarcely can be classified as soil. These places are shown on the soil map, like other mapping units, but they are given descriptive names, such as Rough broken land or Gullied land, and are called land types rather than soils.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this failure to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Apache County, Central Part. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association can occur in another, but in a different pattern.

A map that shows soil associations is useful to people who want a general idea of the soils in an area, who want to

compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or other structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The terms for texture used in the title of several of the associations apply to the texture of the surface layer of the major soils. For example, in the title of association 1, the words "gravelly loams and very stony loams" refer to the texture of the surface layer of the Rudd soils.

The soil associations in Apache County, Central Part, are discussed in the pages that follow.

1. *Rudd association*

Well-drained, shallow and very shallow, undulating gravelly loams and very stony loams formed in residuum from basalt

The soils in this association are on plains that have some prominent cinder cones (fig. 2). The vegetation is short grasses, mainly blue grama, side-oats grama, and black grama, and a few juniper trees in local areas. The average annual precipitation is 11 to 13 inches, the average annual temperature is 48° to 52° F., and the frost-free season is 130 to 140 days. Elevations range from 6,000 to 7,500 feet.

This association makes up about 12 percent of the survey area. It is about 85 percent Rudd soils and 15 percent Bandera soils and Stony rock land.

Rudd soils have a surface layer of grayish-brown and dark grayish-brown gravelly loam or very stony loam. This is underlain by grayish-brown gravelly loam. Basalt bedrock is at a depth of 6 to 20 inches.

Soils of this association are used mainly for grazing. If needed, seeding to adapted species of grass is practical only in select areas. Antelope are the main game species and are hunted extensively on this association in season. The minor Bandera soils on the cinder cones are a source of cinders for construction purposes.

2. *Thunderbird association*

Well-drained, moderately deep, gently rolling cobbly clay loams formed in residuum from basalt and cinders

The soils in this association are on plains that have some prominent cinder cones. The vegetation is juniper trees and short grasses, mainly blue grama, side-oats grama, black grama, and galleta. Juniper grows in thick stands in some areas. The average annual precipitation is 16 to 20 inches, the average annual temperature is 47° to 49° F., and the frost-free season is 130 to 140 days. Elevations range from 6,000 to 7,400 feet.

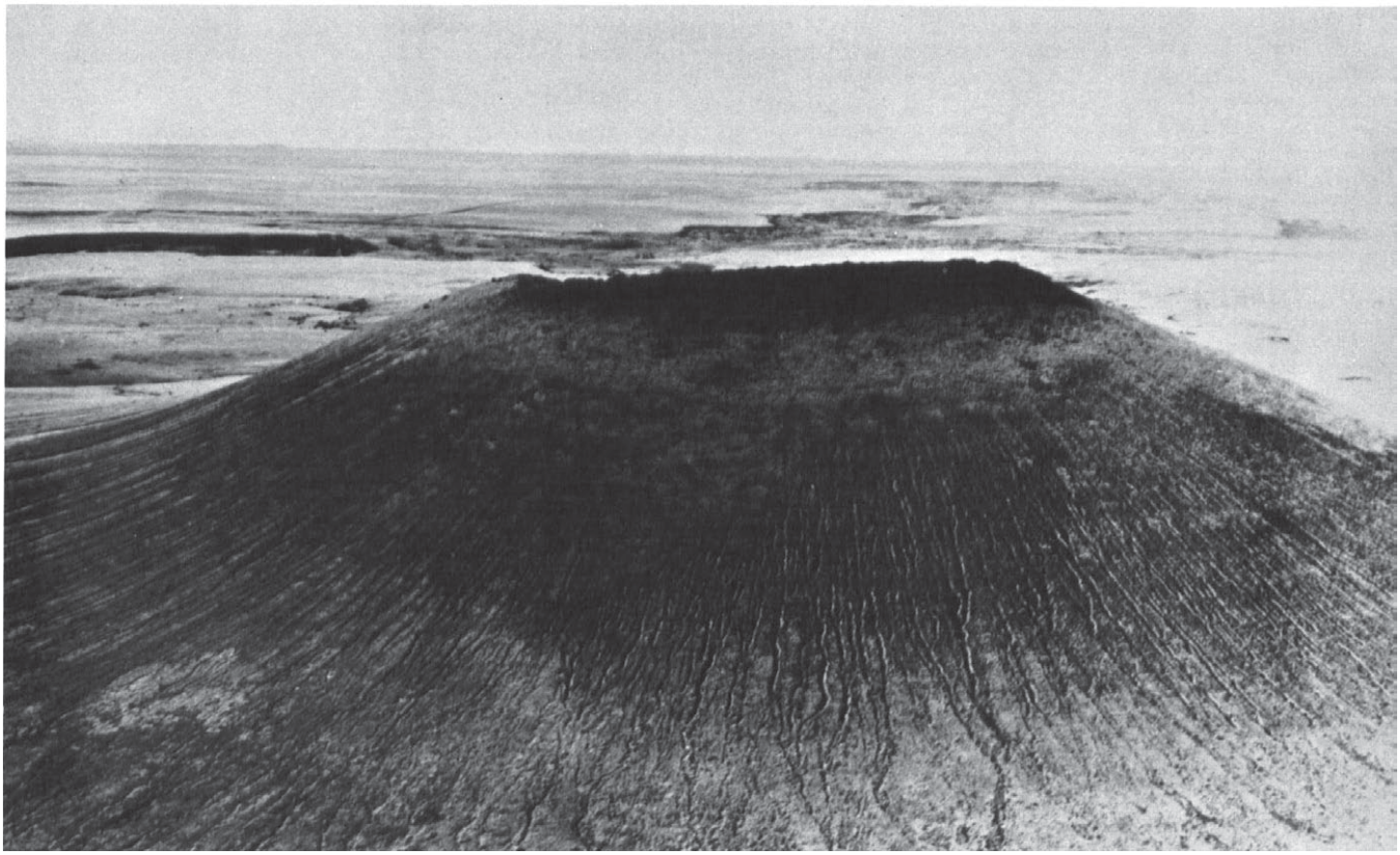

Figure 2.—Volcanic cinder cone in the Rudd association.

This association makes up about 10 percent of the survey area. It is about 60 percent Thunderbird soils and 40 percent Bandera, Springerville, and Ziegler soils.

Thunderbird soils have a surface layer of dark-brown cobbly clay loam and a subsoil of dark-brown clay. Basalt bedrock is at a depth of 20 to 30 inches.

Soils of this association are used mainly for grazing. If needed, seeding to adapted species of grass is practical in most areas. Antelope are the main game species, and some deer are also found on this association. Both antelope and deer are hunted extensively. Generally, the depth to bedrock and high shrink-swell potential of these soils present severe limitations for many nonfarm uses. The minor Bandera and Ziegler soils on the cinder cones are a source of cinders for construction purposes.

3. *Moenkopie-Sandstone rock land association*

Well-drained, shallow and very shallow, nearly level to moderately sloping loamy sands formed in residuum from sandstone, and sandstone rock outcrops

The soils in this association are on hills, broad plains, and mesa caps. The vegetation is juniper trees and short grasses and shrubs, mainly blue grama, galleta, black grama, sand dropseed, snakeweed, and rabbitbrush. The average annual precipitation is 8 to 12 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 130 to 140 days. Elevations range from 5,400 to 7,000 feet.

This association makes up about 5 percent of the survey area. It is 50 percent Moenkopie soils, 45 percent Sandstone rock land, and 5 percent Tours soils and Badland.

Moenkopie soils have a surface layer of reddish-brown loamy sand. This is underlain by reddish-brown sandy loam. Sandstone bedrock is at a depth of 5 to 20 inches. Sandstone rock land is about 60 percent rock outcrop and 40 percent very shallow, sandy soils.

Soils of this association are used mainly for grazing and wildlife habitat. Seeding is practical only in select areas. Deer, dove, and cottontail rabbits are the main game species.

4. *Tours-Jocity association*

Well-drained, deep, nearly level to gently sloping clay loams and sandy clay loams formed in alluvium

The soils in this association are on flood plains and alluvial fans. The vegetation is grasses and shrubs, mainly alkali sacaton, galleta, blue grama, and chamiza. Tamarix, willow, and cottonwood trees are on the sandy riverwash areas. The average annual precipitation is 8 to 12 inches, the average annual temperature is 48° to 55° F., and the frost-free season generally is 120 to 150 days. Elevations generally range from 5,400 to 7,000 feet.

This association makes up 21 percent of the survey area. It is about 40 percent Tours soils, 20 percent Jocity soils, and 40 percent Claysprings, Navajo, Nutrioso, and Clover Springs soils and Loamy alluvial land and Riverwash.

Tours soils have a surface layer of reddish-brown clay loam. This is underlain by reddish-brown clay loam. Jocity soils have a surface layer of reddish-gray sandy clay loam. This is underlain by reddish-gray and light-gray sandy clay loam. Soils of both series are more than 60 inches deep to bedrock.

Soils of this association are used mainly for grazing, but much of the farming in the survey area is done on them. Small grains, alfalfa, pasture grasses, and row crops are the main crops grown. Seeding to adapted species of grass is practical in most areas. Antelope and doves are hunted on this association, and ducks are hunted on the permanent streams, lakes, and ponds.

5. *Badland-Claysprings association*

Barren, eroded land and well-drained, shallow, undulating clays formed in residuum from clayey shales

This association consists mainly of hilly to extremely steep, eroded land and undulating soils on plains near drainageways. The vegetation on the shallow soils is a sparse cover of grasses and brush, chiefly alkali sacaton, galleta, and chamiza. The average annual precipitation is 8 to 13 inches, the average annual temperature is 50° to 54° F., and the frost-free season is about 130 to 140 days. Elevations range from 5,400 to 6,500 feet.

This association makes up about 7 percent of the survey area. It is about 70 percent Badland, 25 percent Clay springs soils, and 5 percent Jocity and Tours soils and Stony rock land.

Badland consists of red and gray soft shale of the Chinle Formation that is dissected by numerous intermittent drainageways. It is known locally as Painted Desert. Claysprings soils are reddish-brown clay that is underlain by clay shale at a depth of 10 to 20 inches.

Soils of this association are used for esthetic purposes and limited grazing. Seeding to adapted species of grass is practical only to a limited extent in areas of Claysprings soils. Antelope are occasionally found on this association.

6. *Clovis-Palma-Hubert association*

Well-drained, deep, nearly level to undulating loamy sands and gravelly loams formed in eolian sands and alluvium

The soils in this association are on plains and low hills. The vegetation is grass, shrubs, and juniper. The dominant grasses are blue grama, galleta, and Indian ricegrass, and the dominant shrubs are chamiza, winterfat, and rabbitbrush. The average annual precipitation is 8 to 14 inches, the average annual temperature is 47° to 55° F., and the frost-free season is 120 to 140 days. Elevations range from 5,400 to 7,500 feet.

This association makes up about 44 percent of the survey area. It is about 45 percent Clovis soils, 25 percent Palma soils, 10 percent Hubert soils, and 20 percent Sheppard, Millett, Hereford, and Eagar soils.

Clovis soils have a surface layer of brown loamy sand and a subsoil of reddish-brown sandy clay loam that is underlain by brown loamy sand and light-brown sandy loam. Palma soils have a surface layer of brown loamy sand, a subsoil of reddish-brown sandy loam, and underlying material of light-brown fine sandy loam. Hubert soils have a surface layer of brown gravelly loam and a subsoil of light brownish-gray gravelly loam that is underlain by white very gravelly loam and pinkish-white gravelly clay loam. All of these soils are more than 60 inches deep to bedrock.

Soils of this association are used mainly for grazing. Small irrigated areas are used for small grain, alfalfa, row crops, and orchards. Seeding to adapted species of grass is

practical in favorable years. Eradication of juniper improves the range where needed, except on the sandy soils. Antelope, deer, dove, and cottontail rabbits are the main game species. In dry seasons the sandy Sheppard soils are an obstacle to vehicular traffic, except on improved roads.

7. *Bushvalley-Cambern association*

Well-drained, very shallow to moderately deep, gently sloping to steep sandy loams, cobbly sandy loams, and loams formed in residuum from tuff

The soils in this association are on mountainsides and ridges. The association is characterized by U-shaped valleys, alluvial fans, and rounded ridges. The vegetation is typically an open stand of ponderosa pine and an understory of grass, mainly blue grama, squirreltail, and bluegrass. Grass is dominant in the valleys. The average annual precipitation is 18 to 24 inches, the average annual temperature is 36° to 45° F., and the frost-free season is 80 to 90 days. Elevations range from about 7,800 to 8,600 feet.

This association makes up about 1 percent of the survey area. It is about 60 percent Bushvalley soils, 15 percent Cambern soils, and 25 percent Clover Springs and Luth soils. The Luth soils are frequently wet to the surface during July and August.

Bushvalley soils have a surface layer of dark-brown loam or cobbly sandy loam and a subsoil of dark-brown very cobbly clay loam. This is underlain by tuff at a depth of 7 to 20 inches. Cambern soils have a surface layer of dark-gray sandy loam and loam and a subsoil of dark grayish-brown clay loam. Tuff is at a depth of 20 to 40 inches.

Soils of this association are used mainly for homesites, range, wildlife habitat, and watershed. Small areas are dryfarmed to small grains for hay and pasture. Deer, elk, black bear, mountain lions, and wild turkeys are the main game species.

Descriptions of the Soils

This section describes the soil series and mapping units in Apache County, Central Part. Each soil series is described in detail and then, briefly, each mapping unit in that series. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for dry soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Riverwash, for example, does not belong to a soil series but, nevertheless, is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and range site in which the mapping unit has been placed. The page for the description of each capability unit and range site can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*2*).[1]

Badland

Badland (BA) consists of very severely eroded, hilly to extremely steep, almost barren land that is dissected by many intermittent drainageways. Ordinarily, this land is not stony. The material is mainly soft shale of the Chinle Formation, generally banded and multicolored in shades of red and gray. It contains numerous large pieces of petrified wood, especially in the Petrified Forest National Park. Slopes are short and complex. Locally, the relief ranges from 10 to about 500 feet. Elevations range from 5,400 to 6,500 feet. Runoff is very rapid, and the hazard of erosion is high. The average annual precipitation is 8 to 12 inches.

Included with this land in mapping are areas of less sloping Claysprings clay, which makes up about 5 percent of the total acreage. Also included, in drainageways, are areas of Tours clay loam and Jocity sandy clay loam, each of which makes up 1 percent.

The largest area of this land is in a national park and is used for esthetic purposes and wildlife habitat. Smaller areas generally are not fenced off from adjoining range and thus are used to a limited extent for grazing. This land type is nearly barren of vegetation, but snakeweed and chamiza grow in the drainageways, and there is a sparse stand of alkali sacaton and galleta. Capability unit VIIIe–1, dryland; not placed in a range site.

Bandera Series

The Bandera series consists of well-drained soils that formed on fans and toe slopes of volcanic cinder cones. Slopes are smooth and range from 0 to 60 percent. Elevations range from 6,000 to 7,500 feet. The average annual precipitation is 12 to 16 inches, the average annual temperature is 45° to 47° F., and the frost-free season is 120 to 130 days. The vegetation is mainly blue grama and a few annuals and cholla cacti.

[1] Italic numbers in parentheses refer to Literature Cited, p. 70.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acreage	Percent
Badland	94, 590	4. 5
Bandera gravelly loam, 0 to 8 percent slopes	2, 570	. 1
Bandera gravelly loam, 8 to 60 percent slopes	19, 270	. 9
Bandera extremely rocky loam, 0 to 8 percent slopes	1, 870	. 1
Bushvalley cobbly sandy loam, 5 to 40 percent slopes	8, 210	. 4
Bushvalley loam, 1 to 5 percent slopes	1, 000	(1)
Cambern sandy loam, 1 to 3 percent slopes	920	(1)
Cambern sandy loam, 3 to 5 percent slopes	900	(1)
Cambern sandy loam, 5 to 10 percent slopes	830	(1)
Claysprings clay, 1 to 5 percent slopes	1, 050	(1)
Claysprings clay, 0 to 8 percent slopes	27, 460	1. 3
Clover Springs silt loam	2, 180	. 1
Clover Springs silt loam, 1 to 3 percent slopes	3, 080	. 1
Clover Springs silt loam, 3 to 5 percent slopes	1, 300	. 1
Clover Springs silt loam, 5 to 10 percent slopes	810	(1)
Clovis loamy sand, 0 to 8 percent slopes	211, 640	10. 0
Clovis fine sandy loam, 1 to 3 percent slopes	780	(1)
Clovis fine sandy loam, 3 to 5 percent slopes	630	(1)
Clovis gravelly fine sandy loam, 1 to 3 percent slopes	450	(1)
Clovis gravelly fine sandy loam, 3 to 5 percent slopes	500	(1)
Clovis gravelly fine sandy loam, 5 to 20 percent slopes	490	(1)
Clovis sandy clay loam, 1 to 3 percent slopes	4, 460	. 2
Clovis sandy clay loam, 3 to 5 percent slopes	770	(1)
Clovis sandy clay loam, thin solum, 1 to 3 percent slopes	350	(1)
Clovis sandy clay loam, thin solum, 3 to 5 percent slopes	4, 340	. 2
Clovis-Palma association, undulating	330, 050	15. 6
Eagar loam, 1 to 3 percent slopes	1, 110	. 1
Eagar loam, 3 to 5 percent slopes	600	(1)
Eagar loam, 5 to 10 percent slopes	540	(1)
Eagar loam, 10 to 30 percent slopes	390	(1)
Eagar gravelly loam, 0 to 5 percent slopes	450	(1)
Eroded land	84, 300	4. 0
Fruitland sandy loam, 1 to 8 percent slopes	48, 410	2. 3
Fruitland loam, cold variant, 1 to 5 percent slopes	1, 830	. 1
Gullied land	18, 980	. 9
Hereford loam, 0 to 8 percent slopes	4, 210	. 2
Hereford loam, 1 to 3 percent slopes	1, 440	. 1
Hereford loam, 3 to 5 percent slopes	820	(1)
Hereford gravelly loam, 0 to 3 percent slopes	350	(1)
Hereford loam, heavy variant, 1 to 3 percent slopes	640	(1)
Hereford stony loam, heavy variant, 3 to 5 percent slopes	330	(1)
Hubert gravelly loam, 0 to 8 percent slopes	67, 450	3. 2
Hubert gravelly loam, 2 to 15 percent slopes, eroded	41, 050	1. 9
Jocity sandy loam, 0 to 3 percent slopes	620	(1)
Jocity sandy clay loam	63, 610	3. 0
Jocity-Claysprings complex	35, 560	1. 7
Loamy alluvial land	49, 950	2. 4
Luth clay loam, seeped, 0 to 1 percent slopes	430	(1)
Luth clay loam, seeped, 1 to 3 percent slopes	1, 070	. 1
Millett gravelly sandy loam, 8 to 30 percent slopes	26, 390	1. 2
Moenkopie loamy sand, 0 to 8 percent slopes	22, 860	1. 1
Moenkopie very rocky loamy sand, 0 to 30 percent slopes	22, 430	1. 1
Navajo sandy clay loam, 1 to 3 percent slopes	1, 810	. 1
Navajo sandy clay loam, 3 to 5 percent slopes	2, 380	. 1
Navajo clay	40, 050	1. 9
Navajo clay, 0 to 1 percent slopes	2, 560	. 1
Navajo clay, 1 to 3 percent slopes	880	(1)
Navajo clay, 3 to 5 percent slopes	940	(1)
Navajo clay, saline-alkali, 0 to 1 percent slopes	10, 280	. 5
Nutrioso loam	1, 480	. 1
Nutrioso loam, 0 to 1 percent slopes	1, 410	. 1
Nutrioso loam, 1 to 3 percent slopes	3, 670	. 2
Nutrioso loam, 3 to 5 percent slopes	370	(1)
Palma loamy sand, 0 to 8 percent slopes	32, 430	1. 5
Palma-Sheppard association, undulating	139, 210	6. 6
Riverwash	4, 210	. 2
Rough broken land	3, 140	. 1
Rudd loam, 1 to 3 percent slopes	1, 250	. 1
Rudd stony loam, 1 to 45 percent slopes	2, 330	. 1
Rudd complex, 0 to 8 percent slopes	195, 280	9. 2
Sandstone rock land	48, 680	2. 3
Sandy alluvial land	15, 530	. 7
Shay clay	720	(1)
Sheppard loamy sand, 0 to 8 percent slopes	25, 480	1. 2
Springerville clay	1, 550	. 1
Springerville cobbly clay, 0 to 8 percent slopes	13, 440	. 6
Stony rock land	37, 290	1. 8
Thunderbird gravelly clay loam, 1 to 5 percent slopes	1, 870	. 1
Thunderbird cobbly clay loam, 0 to 15 percent slopes	122, 430	5. 8
Tours sandy loam	4, 310	. 2
Tours loam	11, 200	. 5
Tours sandy clay loam, 3 to 5 percent slopes	750	(1)
Tours clay loam	137, 640	6. 5
Tours clay loam, 0 to 1 percent slopes	2, 760	. 1
Tours clay loam, 1 to 3 percent slopes	2, 300	. 1
Tours clay loam, saline-alkali	1, 950	. 1
Travertine rock land	11, 230	. 5
Winona fine sandy loam, 0 to 8 percent slopes	8, 650	. 4
Ziegler gravelly loam, 1 to 5 percent slopes	340	(1)
Ziegler gravelly clay loam, 0 to 8 percent slopes	4, 520	. 2
Ziegler gravelly clay loam, 8 to 60 percent slopes	1, 160	. 1
Total	2, 113, 800	100. 0

[1] Less than 0.05 percent.

In a representative profile, the surface layer is brown gravelly loam and dark-brown very gravelly loam about 19 inches thick. The underlying material is gray to black cinders that extend to a depth of 60 inches. The soil is slightly acid to a depth of 2 inches and calcareous and moderately alkaline below that depth.

Permeability is moderately rapid, and the available water capacity is moderate. The effective root depth is 60 inches or more.

Bandera soils are used for range and wildlife habitat. They are also a source of cinders for construction purposes.

Representative profile of Bandera gravelly loam, 0 to 8 percent slopes, under grass, about 9 miles northwest of Springerville, 100 feet east and 100 feet south of the center of sec. 28, T. 10 N., R. 28 E. (See table 7 for laboratory data.)

A11—0 to 2 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak, medium and thick,

platy structure; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; many fine roots; many, fine, interstitial pores and few, fine, tubular pores; surface covered with cinders that range from 2 millimeters to three-fourths inch in diameter; slightly acid; clear, smooth boundary.

A12—2 to 19 inches, dark-brown (10YR 4/3) very gravelly loam, very dark grayish brown (10YR 3/2) moist; massive; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; many fine roots; many, fine, interstitial pores; slightly effervescent in spots; moderately alkaline; gradual, wavy boundary.

IIC1ca—19 to 36 inches, very dark gray (5YR 3/1) and gray (5YR 5/1) gravel-sized cinders, dark reddish brown (5YR 2/2 and 3/3) moist; single grained; loose when dry and moist; few fine roots; many, fine and medium, interstitial pores; 5 percent cobble-sized cinders 3 to 8 inches in diameter; many, medium, light-gray (5YR 7/2) lime coatings, grading to common and fine with increasing depth; violently effervescent; moderately alkaline; gradual, wavy boundary.

IIC2—36 to 60 inches, black (N 2/0) cinders that have thin brown (7.5YR 5/4) coatings, black (N 2/0) and dark brown (7.5YR 3/2) moist; single grained; loose when dry and moist; few fine roots; many, fine and medium, interstitial pores; 5 percent cobble-sized cinders 3 to 8 inches in diameter; strongly effervescent; common, fine, white (N 8/0) lime coatings; moderately alkaline.

Depth to cinders ranges from 6 to 36 inches. The soil ranges from 5YR to 10YR in hue, from 0 to 4 in chroma, and from 2 to 5 in value. The A horizon ranges from 30 to 80 percent coarse fragments. The C horizon is 95 to 100 percent coarse fragments, and as much as 10 percent of these fragments is more than 3 inches in diameter.

Bandera gravelly loam, 0 to 8 percent slopes (BDB).—This soil is on large, smooth fans that generally extend northeastward from the source of the parent cinders. It has the profile described as representative of the series. Slopes generally are 3 to 8 percent. Depth to the cinders ranges from 12 to 36 inches. This soil has a zone of strong lime accumulation that is weakly cemented in approximately 25 percent of the mapping unit. Included in mapping are areas of rock outcrop that make up about 1 percent of the acreage.

Runoff is slow, and the hazard of erosion is slight. The available water capacity is moderate. This soil is used for range and wildlife habitat and as a source of cinders for construction. Capability unit VIe–1, dryland; Cinder Upland range site, 12 to 16 inches precipitation.

Bandera gravelly loam, 8 to 60 percent slopes (BDE).—This soil is on cinder cones that range from 50 to 400 feet in height and from 40 to 320 acres in size. About one-fourth of the acreage of this soil is strongly sloping to moderately steep, one-half is steep, and one-fourth is very steep. This soil has a profile similar to the one described as representative of the series, but depth to the cinders ranges from 6 to 20 inches.

Included with this soil in mapping are outcrops of raw cinders that have slopes of more than 50 percent and make up 15 percent of the acreage. Also included are areas of rock outcrops and areas of Rudd stony loam and Thunderbird cobbly clay loam near the base of the cones. Each of these inclusions makes up about 2 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate. The available water capacity is moderate. This soil is used for range and wildlife habitat and as a source of cinders for construction. Capability unit VIIe–1, dryland; Cinder Upland range site, 12 to 16 inches precipitation.

Bandera extremely rocky loam, 0 to 8 percent slopes (BEB).—This soil is on recent cinder cones and lava flows. Depth to the cinders ranges from 12 to 36 inches. This mapping unit is easily identified by the many, protruding, jagged outcrops of black lava that are as much as 15 feet high and make up about 30 percent of the acreage. Slopes are mostly convex and generally are 1 to 3 percent.

Runoff is slow, and the hazard of erosion is slight. The available water capacity is moderate. This soil is used for range and wildlife habitat. Capability unit VIIs–1, dryland; Cinder Upland range site, 12 to 16 inches precipitation.

Bushvalley Series

The Bushvalley series consists of well-drained soils that formed in residuum derived mainly from hard tuff on mountainsides and ridges. Slopes are 1 to 40 percent. Elevations range from about 7,800 to 8,600 feet. The average annual precipitation is 18 to 24 inches, the average annual temperature is 36° to 45° F., and the frost-free season is about 80 to 90 days. The vegetation is an open stand of ponderosa pine and an understory of blue grama, squirreltail, and bluegrass.

In a representative profile, the surface layer is neutral, dark-brown cobbly sandy loam about 5 inches thick. The subsoil is slightly acid, dark-brown very cobbly clay loam that is about 5 inches thick and is underlain by light-brown, hard tuff bedrock.

Permeability is moderately slow, and the available water capacity is low. The effective root depth is 7 to 20 inches.

Bushvalley soils are used for homesites, range, wildlife habitat, and watershed.

Representative profile of Bushvalley cobbly sandy loam, 5 to 40 percent slopes, under forest cover, 1,452 feet north and 396 feet east of the south quarter corner of sec. 2, T. 5 N., R. 30 E., about one-fourth mile northwest of Alpine.

O1—½ inch to 0, pine needles.

A1—0 to 5 inches, dark-brown (7.5YR 4/2) cobbly sandy loam, dark brown (7.5YR 3/2) moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; many fine and medium roots; many, fine, interstitial pores and few, fine, tubular pores; neutral; abrupt, smooth boundary.

B2—5 to 10 inches, dark-brown (7.5YR 4/2) very cobbly clay loam, dark brown (7.5YR 3/2) moist; interiors of broken cobbles are light brown (7.5YR 6/4) when dry and brown (7.5YR 5/4) when moist; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many fine and common medium roots; many, fine, interstitial pores; few thin clay films on ped faces and in pores; 80 percent cobbles and gravel; slightly acid; abrupt, irregular boundary.

R—10 to 14 inches, light-brown (7.5YR 6/4) hard tuff, brown (7.5YR 5/4) moist.

Depth to underlying rock ranges from 7 to 20 inches. The A horizon ranges from 7.5YR to 10YR in hue, is 1 or 2 in chroma, and is 4 or 5 in value when dry and 2 or 3 when moist. It is cobbly sandy loam or loam that is 5 to 30 percent coarse fragments, and it ranges from medium acid to neutral in reaction. The B horizon ranges from 7.5YR to 5YR in hue but is mainly 7.5YR; it is 2 or 3 in chroma and ranges from 3 to 5

in value when dry and is 3 or 2 when moist. It is very cobbly loam or very cobbly clay loam that is more than 50 percent coarse fragments, and it ranges from slightly acid to moderately alkaline. The structure is controlled by coarse fragments, but it includes weak or moderate, fine or medium, subangular blocky structure. In places, however, the horizon is massive.

Bushvalley cobbly sandy loam, 5 to 40 percent slopes (BsE).—This soil is on mountainsides and high on the sides of ridges. It has the profile described as representative of the series. Slopes generally are 10 to 20 percent. Included in mapping are areas of Cambern sandy loam that make up about 4 percent of the acreage and areas of Clover Springs silt loam that make up 5 percent.

Runoff is medium, and the hazard of erosion is slight. A few shallow gullies have been formed. This soil is used for homesites, range, wildlife habitat, and watershed. Capability unit VIIs–1, dryland; Shallow Upland range site, 12 to 16 inches precipitation.

Bushvalley loam, 1 to 5 percent slopes (BuC).—This soil is on the toe slopes and spur ridges of mountains. It has a profile similar to the one described as representative of the series, but the surface layer is loam, 4 to 6 inches thick, that contains 5 to 15 percent cobbles and gravel.

Runoff is slow, and the hazard of erosion is slight. This soil is used for homesites, range, and watershed. In many places it is adjacent to or within the boundaries of cultivated areas and has had the trees removed and has been plowed. These areas are no longer being plowed. Capability unit VIs–1, dryland; Shallow Upland range site, 12 to 16 inches precipitation.

Cambern Series

The Cambern series consists of well-drained soils that formed in residuum derived from tuff on the sides of mountain spurs. Slopes are 1 to 10 percent. Elevations range from 7,800 to 8,600 feet. The average annual precipitation is 20 to 24 inches, the average annual temperature is 36° to 45° F., and the frost-free season is 80 to 90 days. The vegetation is mainly blue grama, mountain muhly, and squirreltail and scattered ponderosa pine.

In a representative profile, the surface layer is slightly acid and neutral, dark-gray sandy loam and loam about 10 inches thick. The subsoil is neutral, dark-gray heavy loam and dark grayish-brown clay loam that is about 18 inches thick and is underlain by white tuff.

Permeability is moderately slow, and the available water capacity is moderate. The effective root depth is 20 to 40 inches.

Cambern soils are used mainly for homesites, range, wildlife habitat, and watershed. Small areas are dryfarmed to small grains for hay and pasture.

Representative profile of Cambern sandy loam, 5 to 10 percent slopes, about 3 miles east of Alpine, 300 feet south and 50 feet west of the southeast corner of sec. 16, T. 5 N., R. 31 E.

O1—½ inch to 0, pine needles.
A11—0 to 3 inches, dark-gray (10YR 4/1) sandy loam, very dark brown (10YR 2/2) moist; moderate, medium, platy structure; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; many fine and medium roots; many, fine, interstitial pores and few, fine, tubular pores; slightly acid; clear, smooth boundary.
A12—3 to 10 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) moist; weak, medium and coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many fine roots and common medium roots; many, fine, interstitial pores and few, fine, tubular pores; neutral; gradual, smooth boundary.
B1—10 to 14 inches, dark-gray (10YR 4/1) heavy loam, very dark brown (10YR 2/2) moist; moderate, medium and coarse, subangular blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; many fine roots, common medium roots, and few coarse roots; common, fine, interstitial pores and few, fine, tubular pores; neutral; gradual, smooth boundary.
B21t—14 to 20 inches, dark-gray (10YR 4/1) clay loam, very dark brown (10YR 2/2) moist; moderate, medium and coarse, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; many fine roots and few medium roots; common, fine, interstitial pores and few, fine, tubular pores; common thin clay films on ped faces and in pores; neutral; clear, smooth boundary.
B22t—20 to 28 inches, dark grayish-brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; many fine roots and few medium roots; common, fine, interstitial and tubular pores; common moderately thick clay films on ped faces and in pores; 10 percent, by volume, very pale brown (10YR 7/3) fragments of decomposing tuff, yellowish brown (10YR 5/4) moist; neutral; abrupt, irregular boundary.
R—28 to 40 inches, white (N 8/0) tuff, pinkish gray (7.5YR 7/2) moist.

Depth to the R horizon ranges from 20 to 40 inches but generally is 24 to 40 inches. The soil ranges from medium acid to neutral in reaction. The A horizon is 10YR and 7.5YR in hue, ranges from 1 to 3 in chroma, and is 4 or 5 in value when dry and 2 or 3 when moist. The B horizon is 7.5YR and 10YR in hue, ranges from 1 to 3 in chroma, and is 3 to 5 in value when dry and 2 or 3 when moist. It is heavy loam, clay loam, or gravelly clay loam. Where gravel, cobbles, or stones occur in the profile, their content is less than 25 percent by volume.

Cambern sandy loam, 1 to 3 percent slopes (CaB).—This soil is on low ridgetops and on the sides of broad mountain valleys. Included with it in mapping are small areas where depth to bedrock is 40 to 50 inches.

Runoff is slow, and the hazard of erosion is slight. This soil is used chiefly for homesites, range, wildlife habitat, and watershed. Small areas are farmed to small grains for hay and pasture. Capability unit IVe–5, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Cambern sandy loam, 3 to 5 percent slopes (CaC).—This soil is on the sides of mountain spurs.

Runoff is medium, and the hazard of erosion is moderate. This soil is used mainly for homesites, range, wildlife habitat, and watershed. Some small areas are dryfarmed to small grains for hay and pasture. Capability unit IVe–5, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Cambern sandy loam, 5 to 10 percent slopes (CaD).—This soil is on the sides of mountain spurs. It has the profile described as representative of the series. Included with it in mapping are areas where slopes are 10 to 20 percent.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for homesites, range, wildlife habitat, and watershed. It is suitable for cultivation to pasture and small grain for hay. Capability unit IVe–5, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Claysprings Series

The Claysprings series consists of well-drained soils that formed in residuum derived from clayey shale on plains near the breaks to well-defined drainageways. Slopes generally are 1 to 5 percent but range from 0 to slightly more than 8 percent. Elevations range from 5,400 to 6,500 feet. The average annual precipitation is 8 to 13 inches, the average annual temperature is 50° to 54° F., and the frost-free season is 130 to 140 days. The vegetation is sparse and is mainly alkali sacaton, blue grama, galleta, and chamiza.

In a representative profile, the soil is reddish-brown clay, about 18 inches thick, that is underlain by soft, gray, clayey shale. The soil is calcareous and moderately alkaline throughout.

Permeability is very slow, and the available water capacity is low. The effective root depth is 10 to 20 inches.

Claysprings soils are used for range and wildlife habitat.

Representative profile of Claysprings clay, 0 to 8 percent slopes, under a sparse cover of grass, about 4 miles southwest of Saint Johns, at the east quarter corner of sec. 7, T. 12 N., R. 28 E.

A11—0 to 4 inches, reddish-brown (5YR 4/3) clay, reddish brown (5YR 4/3) moist; weak, thick, platy structure and weak, medium, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; few fine and medium roots; very few, fine, tubular pores; slightly effervescent; moderately alkaline; clear, smooth boundary.

C1—4 to 18 inches, reddish-brown (5YR 4/3) clay, reddish brown (5YR 4/4) moist; massive; very hard when dry, firm when moist, sticky and plastic when wet; few fine roots; few, medium, tubular pores; few gypsum crystals in soil material in cracks of the clay shale; slightly effervescent; few medium masses and segregations of pink (5YR 8/3) soft lime; moderately alkaline; abrupt, irregular boundary.

C2—18 to 48 inches, gray (10YR 6/1) clay shale, light brownish gray (10YR 6/2) moist.

Depth to the clayey shale ranges from 10 to 20 inches. The A horizon generally is 5YR in hue but ranges from 10YR to 2.5YR; it is 3 or 4 in chroma and ranges from 4 to 6 in value when dry and 4 or 5 when moist. The C1 horizon ranges from 10YR to 2.5YR in hue, depending on the color of the underlying shale, which is gray, pink, or red.

Claysprings clay, 1 to 5 percent slopes (CcC).—This soil is on shale plains in the vicinity of Saint Johns. Slopes are slightly convex.

Runoff is rapid, and the hazard of erosion is moderate. This soil is used for range and wildlife habitat. Capability unit VIe–1, dryland; Clay Fans range site, 8 to 12 inches precipitation.

Claysprings clay, 0 to 8 percent slopes (CDB).—This undulating soil is on clayey shale plains. It has the profile described as representative of the series. Slopes are convex and generally are 1 to 5 percent. Included in mapping are areas of shale outcrop and areas of more sloping Claysprings clay. These included areas make up 15 percent of the acreage.

Runoff is rapid, and the hazard of erosion is moderate. This soil is used for range and wildlife habitat. Capability unit VIe–1, dryland; Clay Fans range site, 8 to 12 inches precipitation.

Clover Springs Series

The Clover Springs series consists of moderately well drained soils that formed in alluvium derived from basalt, tuff, and cinders. These soils are along drainageways in narrow parks and meadows and on flood plains, low terraces, and toe slopes of alluvial fans. Slopes generally are 0 to 5 percent but range from 0 to 10 percent. Elevations range from 6,800 to 8,000 feet. The average annual precipitation is 16 to 24 inches, the average annual temperature is 43° to 46° F., and the frost-free season is 80 to 90 days. The vegetation is grass and a few junipers, pinon pine, and ponderosa pine in places.

In a representative profile, the surface layer is neutral and mildly alkaline, dark-brown loam and silt loam about 6 inches thick. The underlying material is moderately alkaline, dark-brown loam that reaches to a depth of 60 inches.

Permeability is moderate, and the available water capacity is high. The effective root depth is more than 5 feet.

Clover Springs soils are used mainly for range, wildlife habitat, and watershed. Small areas are dryfarmed to small grains, grass for hay or pasture, and sorghums and corn for forage. In the vicinity of Nutrioso and Vernon, small acreages are irrigated to small grains, hay, or pasture.

Representative profile of Clover Springs silt loam, about one-half mile southeast of Vernon, in the center of the NW¼ sec. 22, T. 10 N., R. 25 E.

A11—0 to 2 inches, dark-brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; moderate, very fine and fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine roots; many, very fine, interstitial pores; neutral; abrupt, smooth boundary.

A12—2 to 6 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate, medium and fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many very fine roots; many, very fine, interstitial and tubular pores; mildly alkaline; clear, smooth boundary.

C1—6 to 28 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine roots; many, very fine, interstitial pores and few, medium, tubular pores; moderately alkaline; gradual, smooth boundary.

C2—28 to 60 inches, dark-brown (7.5YR 4/4) loam, dark brown (7.5YR 3/2) moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; few, very fine and fine, tubular pores; moderately alkaline.

The A horizon is mainly loam or silt loam in texture. The A horizon and upper part of the C horizon are 10YR and 7.5YR in hue, range from 1 to 3 in chroma, and are 3 or 4 in value when dry. Brown and reddish mottles that have hues of 7.5YR and 5YR occur in places in the lower part of the C horizon. A gravel lens can occur at a depth of 40 to 50 inches, but in most places it is absent.

Clover Springs silt loam (CE).—This soil is on narrow flood plains or slightly broader low terraces that are about one-half mile wide. It has the profile described as representative of the series. Slopes generally are 0 to 3 percent but range to as much as 5 percent. Included in mapping are areas of Springerville clay and Thunderbird gravelly clay loam that make up about 1 percent of the acreage.

Runoff is slow, and the hazard of erosion is slight. The hazard of overflow is slight in localized areas on the flood plains. This soil is used for range, wildlife habitat, and watershed. Capability unit VIe–1, dryland; Loam Bottoms range site, 16 to 24 inches precipitation.

Clover Springs silt loam, 1 to 3 percent slopes (CgB).—This soil is on the low parts of alluvial fans and on the gently sloping parts of flood plains. Included in mapping, near Greer and northeast of Vernon, are small areas of somewhat poorly drained soils that are very gravelly below the surface layer. These inclusions are shown on the detailed soil map by a symbol for wet spot.

Runoff is slow, and the hazard of erosion is slight. The hazard of overflow is slight. This soil is used chiefly for range, wildlife habitat, and watershed. It also is used for a limited amount of dryframing to small grains, alfalfa, and sorghum for hay and silage. Capability unit IVe–1, dryland; Loam Bottoms range site, 16 to 24 inches precipitation.

Clover Springs silt loam, 3 to 5 percent slopes (CgC).—This soil is in narrow drainageways and on alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is dark gray and the underlying material is dark grayish brown.

Runoff is medium, and the hazard of erosion is moderate. The hazard of overflow is slight in localized areas. This soil is used mainly for range, wildlife habitat, and watershed. Some small areas are dryfarmed to hay crops, and others, in the vicinity of Nutrioso and Vernon, are irrigated to corn or sorghum for silage or to pasture crops. Capability unit IVe–1, dryland; Loam Bottoms range site, 16 to 24 inches precipitation.

Clover Springs silt loam, 5 to 10 percent slopes (CgD).—This soil is in narrow drainageways in the mountains and on flood plains and alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is dark gray and the underlying material is dark grayish brown. Included in mapping are small areas where the surface layer is fine sandy loam, and in some places there are layers that contain some cobbles at a depth of 2 or 3 feet. Also included are a few places where slopes are as steep as 20 percent.

Runoff is medium, and the hazard of erosion is moderate. The hazard of overflow is slight in localized areas along drainageways. This soil is used for range, wildlife habitat, and watershed. Capability unit IVe–1, dryland; Loam Bottoms range site, 16 to 24 inches precipitation.

Clovis Series

The Clovis series consists of well-drained soils that formed in eolian sand and gravelly alluvium derived from quartzite, gneiss, schist, sandstone, and limestone. These soils are on broad plains and wide, high terraces. Slopes generally are 1 to 6 percent but range from 0 to 20 percent. Elevations range from 5,400 to 7,000 feet. The average annual precipitation is 8 to 16 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 130 to 140 days. The vegetation is mainly black grama, Indian ricegrass, needle-and-thread, blue grama, galleta, rabbitbrush, and scattered juniper.

In a representative profile, the surface layer is brown loamy sand about 3 inches thick. The subsoil, to a depth of about 24 inches, is reddish-brown sandy clay loam. Below this, the subsoil is pink clay loam that extends to a depth of about 30 inches. The underlying material is brown and light-brown loamy sand and sandy loam that extends to a depth of 64 inches. The soil is moderately alkaline in the surface layer, neutral and moderately alkaline in the subsoil, and moderately alkaline in the underlying material. A zone of lime accumulation is between depths of 16 and 30 inches.

Permeability is moderate, and the available water capacity is moderate. The effective root depth is more than 5 feet.

Clovis soils are used for range, wildlife habitat, and irrigated farming. The irrigated farming is in the vicinity of Saint Johns, where sorghum and corn for silage and alfalfa hay are the main crops grown. Material for road fill is obtained from the substratum of these soils in select locations.

Representative profile of Clovis loamy sand, 0 to 8 percent slopes, about 16 miles north of Saint Johns, 1,320 feet south and 153 feet east of the center of sec. 4, T. 15 N., R. 29 E. (See table 7 for laboratory data.)

A1—0 to 3 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) moist; moderate, medium and thick, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; many fine and medium roots; many, fine, interstitial and tubular pores; moderately alkaline; clear, smooth boundary.

B1—3 to 8 inches, reddish-brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate, medium and coarse, subangular blocky structure; hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; many fine and medium roots; common, fine, tubular and interstitial pores; moderately alkaline; gradual, smooth boundary.

B21t—8 to 16 inches, reddish-brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak, medium and coarse, prismatic structure parting to moderate, medium and coarse, angular and subangular blocky; very hard when dry, friable when moist, slightly sticky and plastic when wet; common fine and medium roots; common, fine, interstitial and tubular pores; common thin clay films on ped faces and lining pores; neutral; gradual, smooth boundary.

B22tca—16 to 24 inches, reddish-brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak, medium and coarse, prismatic structure parting to moderate, medium and coarse, subangular and angular blocky; very hard when dry, friable when moist, slightly sticky and plastic when wet; common fine roots; common, fine, tubular and interstitial pores; common thin clay films on ped faces and lining pores; strongly effervescent; few to common, medium, segregations of pink (7.5YR 7/4) lime; moderately alkaline; gradual, smooth boundary.

B3ca—24 to 30 inches, pink (7.5YR 8/4) light clay loam, light brown (7.5YR 6/4) moist; massive; hard when dry, friable when moist, slightly sticky and plastic when wet; common fine roots; common, fine, interstitial and tubular pores; violently effervescent; moderately alkaline; clear, wavy boundary.

IIC1—30 to 58 inches, brown (10YR 5/3) loamy sand, dark yellowish brown (10YR 4/4) moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine roots; common, fine, interstitial pores and few, fine, tubular pores; strongly effervescent; moderately alkaline; abrupt, wavy boundary.

IIIC2ca—58 to 64 inches, light-brown (7.5YR 6/4) heavy sandy loam, dark brown (7.5YR 4/4) moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine and medium roots; common, fine, interstitial pores and few, fine, tubular pores; violently effervescent; moderately alkaline.

The solum generally ranges from 20 to 36 inches in thickness, but in thin solum phases it is 7 to 20 inches thick. The soil is as much as 25 percent gravel. The A1 horizon is loamy sand about 2 to 4 inches thick. In cultivated areas, the Ap horizon is fine

sandy loam, gravelly fine sandy loam, or sandy clay loam about 5 to 8 inches thick. The B horizon is sandy clay loam or clay loam.

Clovis loamy sand, 0 to 8 percent slopes (ClB).—This nearly level to undulating soil is on broad plains. It has the profile described as representative of the series. Slopes generally are 1 to 6 percent. Included in mapping are areas of Palma loamy sand that make up 5 percent of the acreage, areas of Loamy alluvial land that make up 2 percent, areas of Tours soils that make up 1 percent, and areas of Hubert gravelly loam that make up less than 1 percent. Also included, mainly in the northwestern part of the survey area and near Saint Johns, are areas where the surface layer is sandy loam. These inclusions of sandy loam make up about 8 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is slight. About 2 percent of the unit, mainly adjacent to drainageways, is so eroded that all of the surface layer and part of the subsoil are gone. This soil is used for range and wildlife habitat.

Areas of this soil that are in the west-central part of the survey area, where elevations are lower and the average annual precipitation is 8 to 12 inches, support a plant cover that is dominantly Indian ricegrass, black grama, blue grama, and needle-and-thread. Other areas of this soil, where the average annual precipitation is 12 to 16 inches, support wolftail, squirreltail, needle-and-thread, black grama, Indian ricegrass, and mutton bluegrass and produce a total annual yield of at least 150 pounds more per acre per year. Capability unit VIs–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation, and Loamy Upland range site, 12 to 16 inches precipitation.

Clovis fine sandy loam, 1 to 3 percent slopes (CmB).—This soil is on broad, high terraces. It has a profile similar to the one described as representative of the series, but the surface layer is fine sandy loam about 5 to 6 inches thick. Slopes generally are 2 to 3 percent.

Runoff is slow. The hazard of erosion is slight, and the hazard of soil blowing is moderate. This soil is used for homesites, irrigated farming, and range. Crops grown under irrigation are sorghum or corn for silage, small grains, and alfalfa. Capability units IIe–7, irrigated, and VIs–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation.

Clovis fine sandy loam, 3 to 5 percent slopes (CmC).—This soil is on broad terraces. It has a profile similar to the one described as representative of the series, but the surface layer is fine sandy loam about 2 to 5 inches thick.

Runoff is medium. The hazards of erosion and soil blowing are moderate. This soil is used for homesites, irrigated farming, and range. Crops grown under irrigation are sorghum or corn for silage, small grains, and alfalfa. Capability units IIIe–7, irrigated, and VIe–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation.

Clovis gravelly fine sandy loam, 1 to 3 percent slopes (CnB).—This soil is on broad terraces. It has a profile similar to the one described as representative of the series, but the surface layer is gravelly fine sandy loam that is 2 to 6 inches thick and is 15 to 20 percent gravel. Slopes generally are 2 to 3 percent.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for homesites, irrigated farming, and range. Crops grown under irrigation are sorghum or corn for silage, small grains, and alfalfa. Capability units IIe–7, irrigated, and VIs–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation.

Clovis gravelly fine sandy loam, 3 to 5 percent slopes (CnC).—This soil is on broad terraces. It has a profile similar to the one described as representative of the series, but the surface layer is gravelly fine sandy loam that is 15 to 25 percent gravel. Included in mapping is a small area near Vernon where the surface layer is gravelly loam, the subsoil is clay, and the underlying material is very gravelly clay loam.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for homesites, irrigated farming, and range. Crops grown under irrigation are sorghum or corn for silage, small grains, and alfalfa. Capability units IIIe–7, irrigated, and VIe–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation.

Clovis gravelly fine sandy loam, 5 to 20 percent slopes (CnE).—This soil is on terrace breaks and ridges. It has a profile similar to the one described as representative of the series, but the surface layer is gravelly fine sandy loam 2 to 4 inches thick, the subsoil is 10 to 16 inches thick, and the soil material is about 25 percent gravel throughout. Slopes generally are 8 to 15 percent. Included in mapping is a small area near Vernon where the surface layer is gravelly loam, the subsoil is clay, and the substratum is very gravelly clay loam.

Runoff is rapid, and the hazard of erosion is high. This soil is used for range and wildlife habitat. Capability unit VIe–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation.

Clovis sandy clay loam, 1 to 3 percent slopes (CoB).—This soil is on broad terraces. It has a profile similar to the one described as representative of the series, but the original surface layer and the upper part of the subsoil have been mixed by plowing and the present surface layer is sandy clay loam 6 to 9 inches thick. Slopes generally are 2 to 3 percent. Included in mapping are small areas of Clovis sandy clay loam, thin solum, 1 to 3 percent slopes, and small areas where slopes are 0 to 1 percent and the surface layer is clay loam.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for irrigated crops, homesites, and range. Crops grown are sorghum or corn for silage, small grains, and alfalfa. Capability units IIe–7, irrigated, and VIs–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation.

Clovis sandy clay loam, 3 to 5 percent slopes (CoC).—This soil is on broad terraces. It has a profile similar to the one described as representative of the series, but the original surface layer and the upper part of the subsoil have been mixed by plowing and the present surface layer is sandy clay loam 6 to 9 inches thick. Slopes generally are 4 to 5 percent. Included in mapping are small areas of Clovis sandy clay loam, thin solum, 3 to 5 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for irrigated crops, homesites, and range. Crops grown are sorghum or corn for silage, small grains, and alfalfa. Capability units IIIe–7, irrigated, and VIe–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation.

Clovis sandy clay loam, thin solum, 1 to 3 percent slopes (CsB).—This soil is on low ridges on broad terraces. It has a profile similar to the one described as representative of the series, but the original surface layer and the

upper part of the subsoil have been mixed by plowing and the present surface layer is sandy clay loam 6 to 9 inches thick. The combined thickness of the surface layer and subsoil ranges from 7 to 20 inches. Also, the zone of lime accumulation is weakly cemented in parts of most of the mapped areas. Slopes generally are 2 to 3 percent.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for irrigated crops, homesites, and range. Crops grown are sorghum or corn for silage, small grains, and alfalfa. Capability units IIe–7, irrigated, and VIs–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation.

Clovis sandy clay loam, thin solum, 3 to 5 percent slopes (CsC).—This soil is on low ridges on broad terraces. It has a profile similar to the one described as representative of the series, but the original surface layer and the upper part of the subsoil have been mixed by plowing and the present surface layer is sandy clay loam 6 to 9 inches thick. The surface layer and subsoil range from 7 to 20 inches in combined thickness. Also, the zone of lime accumulation is weakly cemented in parts of most of the mapped areas. Slopes generally are 4 to 5 percent.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for irrigated crops, homesites, and range. Crops grown are sorghum or corn for silage, small grains, and alfalfa. Capability units IIIe–7, irrigated, and VIe–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation.

Clovis-Palma association, undulating (CTB).—This mapping unit is about 65 percent Clovis loamy sand, 0 to 8 percent slopes, and 30 percent Palma loamy sand, 0 to 8 percent slopes. The Clovis soil generally is between low ridges of Palma soil, but in some places it is on low ridges. The Palma soil is on low, dunelike ridges that vary as much as 10 feet in relief. Included in mapping are areas of Sheppard loamy sand, 0 to 8 percent slopes, that make up about 5 percent of the acreage.

These soils are used mainly for range and wildlife habitat. Clovis soil in capability unit VIe–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation, and Loamy Upland range site, 12 to 16 inches precipitation. Palma soil in capability unit VIs–1, dryland, and Sand Upland range site, 10 to 14 inches precipitation.

Eagar Series

The Eagar series consists of well-drained soils that formed in gravelly alluvium derived mainly from basic tuff. These soils are on alluvial fans and terraces. Slopes generally are 0 to 2 percent but range to as much as 30 percent. Elevations range from 6,900 to 7,800 feet. The average annual precipitation is 12 to 20 inches, the average annual temperature is 44° to 46° F., and the frost-free season is 80 to 100 days. The vegetation is grasses and some brush.

In a representative profile, the surface layer is very dark grayish-brown and dark-gray gravelly loam about 9 inches thick. The underlying material is gray gravelly loam that is about 5 inches thick and is underlain by light-gray and white gravelly loam and cobbly loam and light yellowish-brown very gravelly sandy loam that extends to a depth of 60 inches. The soil is moderately alkaline and calcareous throughout.

Permeability is moderate, and the available water capacity is low. The effective root depth is more than 5 feet.

Eagar soils are used for irrigated farming, homesites, range, wildlife habitat, and watershed. The irrigated farming is in the vicinity of Eagar. Most of the town of Eagar and much of Springerville are on these soils. Orchards, home gardens, corn or sorghum for silage, small grains, and alfalfa are the main crops grown. Material for road fill is obtained from the underlying material of these soils in select locations.

Representative profile of Eagar gravelly loam, 0 to 5 percent slopes, near the gravel pit just east of the county road, about 1 mile northwest of Springerville, 1,200 feet west of center of sec. 29, T. 9 N., R. 29 E.

A11—0 to 3 inches, very dark grayish-brown (10YR 3/2) gravelly heavy loam, very dark brown (10YR 2/2) moist; moderate, fine and very fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; many very fine roots; many, very fine, interstitial and tubular pores; approximately 15 percent gravel; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

A12—3 to 9 inches, dark-gray (10YR 4/1) gravelly heavy loam, very dark brown (10YR 2/2) moist; moderate, fine and very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine roots; many, very fine, interstitial and tubular pores; 15 percent gravel; strongly effervescent; moderately alkaline; clear, wavy boundary.

C1ca—9 to 14 inches, gray (10YR 5/1) gravelly heavy loam, dark gray (10YR 4/1) moist; weak, very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine roots; many, very fine, interstitial and tubular pores; 40 percent gravel; violently effervescent; white lime coatings on lower sides of gravel; moderately alkaline; clear, irregular boundary.

C2ca—14 to 21 inches, light-gray (10YR 7/2) gravelly heavy loam, grayish brown (10YR 5/2) moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine roots; common, very fine, tubular pores; 40 percent gravel and cobbles; few balls of reddish-brown clay loam ⅛ to ¼ inch thick; violently effervescent; white lime coatings on lower sides of gravel and cobbles; moderately alkaline; clear, wavy boundary.

C3ca—21 to 30 inches, white (10YR 8/1) cobbly heavy loam, light gray (10YR 7/2) moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; many, very fine and fine, interstitial pores; few to common, ⅛- to ¼-inch thick lenses of yellowish-red and reddish-brown iron oxide stains; few small clay balls; 50 percent gravel and cobbles; violently effervescent; thin lime coatings on undersides of gravel and cobbles; moderately alkaline; clear, wavy boundary.

C4—30 to 60 inches, light yellowish-brown (10YR 6/4) very gravelly sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; many, very fine, interstitial pores; 70 percent gravel and cobbles; violently effervescent; moderately alkaline.

Depth to the Cca horizon ranges from 8 to 24 inches. The soil is mildly alkaline to moderately alkaline, but it is mainly moderately alkaline. The A horizon is loam, gravelly loam, light clay loam, or gravelly clay loam. The C horizon is sandy loam, sandy clay loam, heavy loam, or light clay loam that is 40 to 70 percent coarse fragments.

Eagar loam, 1 to 3 percent slopes (EaB).—This soil is on the middle and lower parts of broad alluvial terraces. It has a profile similar to the one described as representative of the series, but the surface layer is about 5 percent

gravel and is about 15 inches thick (fig. 3). Depth to the zone of lime accumulation ranges from 14 to 24 inches in a few places. Slopes generally are 2 or 3 percent.

A temporary water table occurs in some irrigated areas during the growing season as a result of overirrigation and normal ditch losses. Normally, the water table is below a depth of 5 feet, except for 3 or 4 days after irrigation when it may rise to within 3 or 4 feet of the surface.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for irrigated crops and homesites. Capability units IVe–6, irrigated, and VIs–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Eagar loam, 3 to 5 percent slopes (EaC).—This soil generally is on the upper parts of broad alluvial terraces. It has a profile similar to the one described as representative of the series, but the surface layer is about 5 percent gravel.

Figure 3.—**Profile of Eagar loam, 1 to 3 percent slopes. Gravel, cobbles, and lime are at a depth of about 2 feet.**

Runoff is medium, and the hazard of erosion is moderate. This soil is used for irrigated crops, homesites, and watershed. Capability units IVe–6, irrigated, and VIe–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Eagar loam, 5 to 10 percent slopes (EaD).—This soil is mainly on the upper parts of colluvial-alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is about 5 percent gravel and is only 5 inches thick. Included in mapping are small stony areas. These are shown on the detailed soil map by the symbol for stoniness.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, irrigated crops, homesites, and watershed. Capability units IVe–6, irrigated, and VIe–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Eagar loam, 10 to 30 percent slopes (EaE).—This soil is on narrow, somewhat irregular terrace escarpments. It has a profile similar to the one described as representative of the series, but the surface layer is about 10 percent gravel and is about 5 inches thick. Included in mapping are small stony areas. These are shown on the detailed soil map by the symbol for stoniness.

Runoff is rapid, and the hazard of erosion is high. This soil is used for range, homesites, and watershed. Capability unit VIe–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Eagar gravelly loam, 0 to 5 percent slopes (EgC).—This soil is on relatively narrow alluvial terraces. It has the profile described as representative of the series. Slopes generally are 0 to 2 percent.

Runoff is slow, and the hazard of erosion is slight. This soil is used mainly for range and homesites. Small areas are used for irrigated crops. Capability units IVs–6, irrigated, and VIs–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Eroded Land

Eroded land (ER2) consists of deep, eroded soil material that is mainly sandy loam and loamy sand in texture and lies on sandy ridges and terrace escarpments. Numerous exposed areas of the underlying stratified, calcareous, coarse-textured to medium-textured geologic material occur in gully cuts and escarpments. Slopes generally are 0 to 8 percent but range to as much as 15 percent. Elevations range from 6,000 to 6,500 feet. Runoff is very rapid. The hazards of soil blowing and erosion are very high. Accelerated erosion is active in a few uncrossable gullies. Many wind deposited hummocks, as much as 2½ feet high, occur around shrubs and trees. The average annual precipitation is 10 to 16 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 120 to 140 days.

Included with this land in mapping are areas of Fruitland sandy loam that make up about 20 percent of the unit and areas of Palma loamy sand and Clovis loamy sand that make up 1 percent each.

This land type is used for range and wildlife habitat. The vegetation is a sparse cover of grasses and brush under a moderate to thick stand of juniper. Capability unit VIIe–1, dryland; Sand Upland range site, 10 to 14 inches precipitation.

Fruitland Series

The Fruitland series consists of well-drained soils that formed in loamy alluvium on broad, short alluvial fans. Slopes generally are 3 to 6 percent but range from 1 to 8 percent. Elevations range from 5,500 to 7,000 feet. The average annual precipitation is 10 to 13 inches, the average annual temperature is 49° to 53° F., and the frost-free season is 130 to 140 days. The vegetation is blue grama, alkali sacaton, three-awn, and some snakeweed and rabbitbrush.

In a representative profile, the surface layer is brown sandy loam about 4 inches thick. The underlying material, to a depth of about 48 inches, is yellowish-brown sandy loam and brown fine sandy loam. Below this, the material is light brownish-gray gravelly sandy loam that extends to a depth of 62 inches. The soil is calcareous and moderately alkaline throughout.

Permeability is moderately rapid, and the available water capacity is moderate. The effective root depth is more than 5 feet.

These soils are used for range and wildlife habitat.

Representative profile of Fruitland sandy loam, 1 to 8 percent slopes, about 7 miles northeast of Saint Johns, 450 feet east of fence corner in the SE¼NW¼ sec. 20, T. 14 N., R. 29 E.

A1—0 to 4 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak, medium, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many fine roots and few medium roots; many, fine, interstitial pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C1—4 to 20 inches, yellowish-brown (10YR 5/4) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; few fine roots; many, very fine, tubular pores and few, fine, tubular and interstitial pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

C2—20 to 26 inches, yellowish-brown (10YR 5/4) light sandy loam, dark brown (10YR 4/3) moist; massive, slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine roots; many, very fine, tubular pores and few, fine, tubular and interstitial pores; 5 percent fine gravel; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C3ca—26 to 48 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft when dry, friable when moist, slightly sticky and nonplastic when wet; few fine roots; many, very fine, tubular pores and few, fine, tubular and interstitial pores; 5 percent fine gravel; violently effervescent; few, fine, filaments of lime; moderately alkaline; abrupt, smooth boundary.

C4—48 to 62 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, brown (10YR 5/3) moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few fine roots; many, very fine, interstitial pores; 25 percent gravel; violently effervescent; moderately alkaline.

The A horizon ranges from 7.5YR to 10YR in hue, from 2 to 4 in chroma when dry, and from 5 to 7 in value when dry. The C horizon ranges from 7.5YR to 10YR in hue. The C horizon ranges from loamy sand to fine sandy loam. In some places a scattering of quartzite gravel occurs throughout the lower horizons.

Fruitland sandy loam, 1 to 8 percent slopes (FRB).—This soil is on broad, relatively short alluvial fans. Slopes are smooth and generally range from 3 to 6 percent. Approximately 5 percent of this mapping unit is Sandy alluvial land, 3 percent is Palma loamy sand, 3 percent is Loamy alluvial land, and 10 percent is Eroded land.

Runoff is medium, and the hazard of erosion is moderate. Sheet erosion has been slight, and some gullies have been formed. This soil is used for range and wildlife habitat. Capability unit VIe-1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Fruitland Series, Cold Variant

The Fruitland series, cold variant, consists of well-drained soils that formed in alluvium derived from volcanic ash and tuff. These soils are on alluvial fans. Slopes generally are 1 to 3 percent but range to as much as 5 percent. Elevations range from 6,900 to 7,500 feet. The average annual precipitation is 20 to 22 inches, the average annual temperature is about 43° F., and the frost-free season is 90 to 100 days. The vegetation is mainly blue grama, western wheatgrass, mountain brome, squirreltail, and rabbitbrush. In addition, there are a few ponderosa pines.

In a representative profile, the surface layer is light brownish-gray and light-gray loam about 9 inches thick. The underlying material, to a depth of 30 inches, is light brownish-gray fine sandy loam and light-gray loam. Below this, the material is stratified layers of an older, buried soil that is grayish-brown fine sandy loam and sandy loam to a depth of 39 inches and light-gray fine sandy loam that extends to a depth of 60 inches. The profile is moderately alkaline and calcareous throughout.

Permeability is moderately rapid, and the available water capacity is high. The effective root depth is more than 5 feet.

These soils are used for range and watershed. In the vicinity of Eagar, much of the acreage is farmed to irrigated corn or sorghum for silage and to small grains and alfalfa.

Representative profile of Fruitland loam, cold variant, 1 to 5 percent slopes, a few miles north of Nutrioso, 2,000 feet east and 400 feet south of the northwest corner of sec. 11, T. 8 N., R. 29 E.

A11—0 to 2 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; many fine roots; many, fine, interstitial pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

A12—2 to 9 inches, light-gray (10YR 7/2) loam, brown (10YR 5/3) moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; many fine roots; many, fine, interstitial pores; strongly effervescent; moderately alkaline; gradual, smooth boundary.

C1—9 to 24 inches, light brownish-gray (10YR 6/2) fine sandy loam, brown (10YR 5/3) moist; massive parting to weak, fine and medium, subangular blocky structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; common fine roots; common, fine, interstitial pores; strongly effervescent; moderately alkaline; gradual, smooth boundary.

C2—24 to 30 inches, light-gray (10YR 7/2) loam, brown (10YR 5/3) moist; massive; slightly hard when dry, very friable when moist, slightly sticky and plastic when wet; many fine roots; few, fine, tubular pores and common, fine, interstitial pores; violently effervescent; moderately alkaline; abrupt, smooth boundary.

A11b—30 to 34 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard when dry, very friable when moist, slightly sticky and plastic when wet; common fine roots; few, fine, tubular pores and common, fine, interstitial pores; effervescent; moderately alkaline; clear, smooth boundary.

A12b—34 to 39 inches, grayish-brown (2.5Y 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive, hard when dry, very friable when moist, nonsticky and slightly plastic when wet; common fine roots; few, fine, tubular pores and common, fine, interstitial pores; 5 percent fine gravel; strongly effervescent; moderately alkaline; clear, wavy boundary.

C3b—39 to 60 inches, light-gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) moist; massive; hard when dry, very friable when moist, nonsticky and slightly plastic when wet; few fine roots; many, fine, interstitial pores and few, fine, tubular pores; 10 percent gravel; violently effervescent; moderately alkaline.

The A horizon ranges from 7.5YR to 10YR in hue, from 2 to 4 in chroma when dry, and from 5 to 7 in value when dry. A weak Cca horizon occurs in places. As much as 15 percent gravel can occur in any horizon. The gravel consists of angular to flat pieces of tuff that are ¼ to ½ inch thick and as much as 1½ inches across.

Fruitland, cold variant soils, in this survey area are about 5 degrees colder than is defined for the Fruitland series.

Fruitland loam, cold variant, 1 to 5 percent slopes (FuC).—This soil is on alluvial fans along the outside edges of mountain valleys. Included in mapping are small areas where slopes are as steep as 10 percent.

Runoff is slow. The hazard of erosion is slight, and the hazard of soil blowing is moderate. This soil is used for range and irrigated farming. The principal crops are corn or sorghum for silage, alfalfa, and small grains. Capability units IIIe–1, irrigated, and VIe–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Gullied Land

Gullied land (GU) consists of areas so cut by gullies that all soil profiles have been destroyed. The material is made up of deep, calcareous, soft, sandy to loamy, wind- and water-laid material and a few lenses of weakly cemented sandstone in places. This land type is moderately steep to extremely steep on sandy escarpments and ridges. Slopes range from 15 to 100 percent. Locally, the relief ranges from 6 to about 50 feet. Elevations range from 5,400 to 6,500 feet. Runoff is very rapid. The hazards of soil blowing and erosion are very high. The average annual precipitation is 10 to 12 inches, the average annual temperature is 52° to 55°F., and the frost-free season is 130 to 160 days.

Included with this land in mapping are areas of Sandy alluvial land that make up about 5 percent of this unit. A typical area of this land type is in the west half of section 11, T. 19 N., R. 29 E. This land type generally is not fenced from adjoining range and thus is used to a limited extent for grazing as well as wildlife habitat. The vegetation is a very sparse stand of juniper, blue grama, black grama, alkali sacaton, and chamiza. Capability unit VIIIe–1, dryland; not placed in a range site.

Hereford Series

The Hereford series consists of well-drained soils that formed in alluvium derived from basalt and tuff. These soils are on broad alluvial fans and terraces. The parent alluvium is from standstone in the Show Low Pines area. Slopes generally are 1 to 3 percent but range from 0 to 8 percent. Elevations range from 6,700 to 7,500 feet. The average annual precipitation is 12 to 13 inches, the average annual temperature is about 47°F., and the frost-free season is 100 to 120 days. The vegetation is blue grama, side-oats grama, and rabbitbrush and a few scattered junipers.

In a representative profile, the surface layer is very dark gray and dark-gray loam about 9 inches thick. The subsoil is dark-gray and gray loam and clay loam about 35 inches thick. The underlying material is gray sandy clay loam that extends to a depth of 60 inches. The soil is moderately alkaline throughout. A zone of lime accumulation is at a depth of about 20 inches.

Permeability is moderately slow, and the available water capacity is generally high. The effective root depth is more than 60 inches except in Hereford gravelly loam, 0 to 3 percent slopes, which is very gravelly and cobbly below a depth of 24 inches and has only moderate available water capacity.

Hereford soils are used chiefly for range, wildlife habitat, and water supply. In the vicinity of Springerville, they are farmed to irrigated alfalfa, small grains, sorghum or corn for silage, orchards, and home gardens and also are used for homesites.

Representative profile of Hereford loam, 3 to 5 percent slopes, about 2 miles southwest of Eagar, 320 feet south and 200 feet west of the east quarter corner of sec. 18, T. 8 N., R. 29 E.

A11—0 to 3 inches, very dark gray (10YR 3/1) loam, very dark brown (10YR 2/2) moist; strong, very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine roots; many, very fine, interstitial pores; moderately alkaline; abrupt, smooth boundary.

A12—3 to 9 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate, fine and very fine, granular structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; many, very fine, tubular and interstitial pores; moderately alkaline; clear, smooth boundary.

B1t—9 to 13 inches, dark-gray (10YR 4/1) heavy loam, very dark gray (10YR 3/1) moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; many, very fine, tubular pores; common thin clay films on ped faces; moderately alkaline; clear, smooth boundary.

B21t—13 to 20 inches, dark-gray (10YR 4/1) light clay loam, very dark gray (10YR 3/1) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; many, very fine, tubular pores; common moderately thick clay films on ped faces and in pores; moderately alkaline; clear, smooth boundary.

B22tca—20 to 30 inches, gray (10YR 5/1) clay loam, very dark gray (10YR 3/1) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard when dry, friable when moist, sticky and plastic when wet; common very fine roots; many, very fine, tubular pores; common moderately thick clay films on ped faces and in pores; strongly effervescent; few fine filaments of white (10YR 8/1) lime; moderately alkaline; clear boundary.

B3ca—30 to 44 inches, gray (10YR 5/1) light clay loam, very dark gray (10YR 3/1) moist; weak, medium, prismatic structure; hard when dry, friable when moist,

sticky and plastic when wet; many very fine roots; common, very fine, tubular pores; violently effervescent; common fine filaments of white (10YR 8/1) lime; moderately alkaline; clear, wavy boundary.

C—44 to 60 inches, gray (10YR 5/1) sandy clay loam, very dark gray (10YR 3/1) moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; many, very fine and fine, tubular pores; violently effervescent; many fine filaments of white (10YR 8/1) lime; moderately alkaline.

The solum ranges from 35 to 55 inches in thickness. The A horizon is mildly alkaline to moderately alkaline in reaction, and the soil in places is slightly effervescent in the A horizon and the upper part of the B horizon. The A horizon is 10YR or 7.5YR in hue, 1 or 2 in chroma, and 2 or 3 in value when moist and 3 or 4 when dry. It is loam or clay loam or their gravelly analogs. The B horizon is 10YR or 7.5YR in hue. It is heavy loam, sandy clay loam, or clay loam or their gravelly analogs. The B2t horizon has weak or moderate, prismatic or subangular blocky structure.

Hereford loam, 0 to 8 percent slopes (HDB).—This soil is on medium-sized alluvial fans and terraces. Slopes are smooth, generally slightly concave, and mainly 1 to 3 percent. Included in mapping, northwest of Springerville, are areas of a similar soil that is subject to inundation for a month or more at a time almost annually.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, wildlife habitat, and watershed. Some areas have been subdivided and are used as homesites. Capability unit VIe–1, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Hereford loam, 1 to 3 percent slopes (HeB).—This soil is on the lower parts of medium-sized alluvial fans. Slopes are smooth and slightly concave.

Runoff is medium, and the hazard of erosion is moderate. This soil is used mainly for range. Much of the acreage, in the vicinity of Springerville, is farmed to irrigated alfalfa, corn or sorghum for silage, small grains, orchards, and home gardens and is also used for homesites. Capability units IIIe–1, irrigated, and VIc–1, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Hereford loam, 3 to 5 percent slopes (HeC).—This soil is on the upper parts of medium-sized alluvial fans. It has the profile described as representative of the series. Slopes are smooth and concave.

Runoff is medium, and the hazard of erosion is moderate. This soil is used mainly for range, wildlife habitat, and watershed. Much of it, in the vicinity of Springerville, is used for irrigated alfalfa, corn or sorghum for silage, small grains, orchards, and home gardens and is also used for homesites. Capability units IIIe–1, irrigated, and VIe–1, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Hereford gravelly loam, 0 to 3 percent slopes (HfB).—This soil is on a small terrace of the Little Colorado River in the vicinity of the Springerville-Eagar Airport. It has a profile similar to the one described as representative of the series, but it is gravelly to a depth of about 2 feet and is very gravelly and cobbly below.

Runoff is slow, and the hazard of erosion is slight. This soil is used mainly as homesites. Small areas are used for farming to irrigated sorghum, corn for silage, small grains, alfalfa, or pasture. Capability units IVs–6, irrigated, and VIs–1, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Hereford Series, Heavy Variant

The Hereford series, heavy variant, consists of well-drained soils that formed in alluvium derived from basalt and tuff. These soils are on low ridges and terraces near Nutrioso Creek. Slopes generally are 1 to 3 percent but range to as much as about 5 percent on the ridges and upper parts of terraces. Elevations range from 7,500 to 8,000 feet. The average annual precipitation is 10 to 16 inches, the average annual temperature is 47° to 48° F., and the frost-free season is 120 to 130 days. The vegetation is blue grama, side-oats grama, and rabbitbrush and a few scattered junipers.

In a representative profile, the surface layer is slightly acid, dark-gray loam about 4 inches thick. The upper part of the subsoil is neutral, dark-gray and brown clay loam about 14 inches thick; the middle part is mildly alkaline, reddish-brown clay about 18 inches thick; and the lower part is mildly alkaline, light reddish-brown cobbly clay loam that extends to a depth of 60 inches. A zone of calcium carbonate accumulation is below a depth of 18 inches.

Permeability is very slow, and the available water capacity is high. The effective root depth is more than 5 feet.

Hereford soils are used mainly for range, wildlife habitat, and watershed. Small areas are farmed to irrigated alfalfa, small grains, and pasture.

Representative profile of Hereford loam, heavy variant, 1 to 3 percent slopes, about 1½ miles north of Nutrioso, 1,340 feet east and 100 feet south of the northwest corner of sec. 29, T. 7 N., R. 30 E.

A11—0 to 2 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate, very fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine roots; many, very fine, interstitial pores; slightly acid; abrupt, smooth boundary.

A12—2 to 4 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; weak, thick, platy structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine roots; common, very fine, tubular pores; slightly acid; abrupt, smooth boundary.

B1t—4 to 12 inches, dark-gray (10YR 4/1) light clay loam, very dark gray (10YR 3/1) moist; strong, coarse, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; many very fine roots; many, very fine, tubular pores; many moderately thick clay films on ped faces and in pores; neutral; clear, wavy boundary.

B21t—12 to 18 inches, brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; strong angular blocky structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; common very fine roots, mostly between peds; many, very fine, tubular pores; thick continuous clay films on ped faces and in pores; some pressure faces on peds because of swelling and shrinking; neutral; clear, wavy boundary.

B22tca—18 to 36 inches, reddish-brown (5YR 5/3) clay, reddish brown (5YR 4/3) moist; moderate to strong, medium, prismatic structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; many moderately thick clay films on ped faces and in pores; few fine flecks of manganese or very small concretions of manganese; noncalcareous, becomes violently effervescent in lower part; few to common, medium, segregations of white lime between peds; mildly alkaline; abrupt, wavy boundary.

B3tca—36 to 60 inches, light reddish-brown (5YR 6/3) cobbly clay loam, reddish brown (5YR 5/3) and has small areas of reddish brown (5YR 4/3) moist; massive;

extremely hard when dry, very firm when moist, very sticky and very plastic when wet; few very fine roots; common thin clay films in pores; 20 percent cobbles; violently effervescent; many, fine, white filaments and veins of lime, thin coatings of lime on pebbles and cobbles; mildly alkaline.

In places the profile has a few rounded pebbles and cobbles from 1 to 5 inches in diameter throughout or the entire profile is cobbly. Depth to the cobbly B3tca horizon ranges from 24 to 36 inches.

Hereford loam, heavy variant, 1 to 3 percent slopes (HhB).—This soil generally is on low, narrow terraces along Nutrioso Creek. It has the profile described as representative of the variant. A few rounded pebbles and cobbles, 1 to 5 inches in diameter, are throughout the profile.

Runoff is medium, and the hazard of erosion is moderate. This soil is used mainly for range. In irrigated areas, alfalfa, small grains, and pasture are grown. Capability units IIIe–8, irrigated, and VIs–1, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Hereford stony loam, heavy variant, 3 to 5 percent slopes (HrC).—This soil is on low ridges and the upper parts of terraces near Nutrioso Creek. It has a profile similar to the one described as representative of the variant, but it is about 5 to 15 percent stones throughout.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, wildlife habitat, and watershed. Capability unit VIs–1, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Hubert Series

The Hubert series consists of well-drained soils that formed in gravelly alluvium derived from quartzite, sandstone, limestone, travertine, and basalt. These soils are on plains and fans. Slopes generally are 1 to 5 percent but range from 0 to 15 percent. Elevations range from 6,000 to 7,500 feet. The average annual precipitation is 12 to 14 inches, the average annual temperature is 47° to 50° F., and the frost-free season is 120 to 140 days. The vegetation is dominantly blue grama, ring muhly, sand dropseed, winterfat, snakeweed, rabbitbrush, and, in places, a few junipers.

In a representative profile, the surface layer is brown gravelly loam about 10 inches thick. The subsoil is light brownish-gray gravelly heavy loam about 5 inches thick. The underlying material is white very gravelly loam and pinkish-white very gravelly clay loam that extends to a depth of 105 inches. The soil is moderately alkaline and calcareous throughout.

Permeability is moderate, and the available water capacity is moderate. The effective root depth is more than 5 feet.

Hubert soils are used for range and wildlife habitat.

Representative profile of Hubert gravelly loam, 0 to 8 percent slopes, about 10 miles northeast of Springerville, 1,000 feet southeast of the northwest corner of sec. 13, T. 10 N., R. 30 E.

A11—0 to 3 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak, medium, platy structure parting to weak, fine, granular; slightly hard when dry, friable when moist, nonsticky and slightly plastic when wet; common fine roots; common, fine, tubular pores and many, fine, interstitial pores; 15 percent gravel; slightly effervescent; moderately alkaline; abrupt, smooth boundary.

A12—3 to 10 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine roots; common, fine, tubular pores and many, fine, interstitial pores; 20 percent gravel; strongly effervescent; moderately alkaline; clear, smooth boundary.

B2—10 to 15 inches, light brownish-gray (10YR 6/2) gravelly heavy loam, dark brown (10YR 4/3) moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; common fine roots; common, fine, tubular pores and many, fine, interstitial pores; 20 percent gravel; violently effervescent; moderately alkaline; gradual, wavy boundary.

C1ca—15 to 48 inches, white (10YR 8/2) very gravelly loam, very pale brown (10YR 7/3) moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; common, fine, tubular pores and many, fine, interstitial pores; 55 percent gravel; violently effervescent; moderately alkaline; gradual, wavy boundary.

C2ca—48 to 105 inches, pinkish-white (7.5YR 8/2) very gravelly clay loam that has common pink (7.5YR 7/4) seams, pink (7.5YR 7/4) and light brown (7.5YR 6/4) moist; massive; very hard when dry, friable when moist, sticky and plastic when wet; few fine roots; few, fine, tubular pores and common, fine, interstitial pores; 60 percent gravel; violently effervescent; moderately alkaline.

The solum generally is 12 to 18 inches thick but ranges from 10 to 26 inches in thickness. The content of gravel between depths of 10 and 40 inches averages 35 to 60 percent by volume. The A horizon is 10YR or 7.5YR in hue, 2 or 3 in chroma, and 4 or 5 in value when dry. The B horizon is 10YR or 7.5YR in hue, 2 or 3 in chroma, and 5 to 7 in value when dry and 4 or 5 when moist. The B horizon is gravelly or very gravelly loam, sandy clay loam, or light clay loam. The Cca horizon is 10YR or 7.5YR in hue, ranges from 2 to 4 in chroma, and is 7 or 8 in value when dry and 6 or 7 when moist.

Hubert gravelly loam, 0 to 8 percent slopes (HUB).—This undulating soil is on broad plains and fans. It has the profile described as representative of the series. Slopes generally are 1 to 5 percent. Included in mapping are areas where the surface layer is very gravelly. These included areas make up about 2 percent of the acreage. Also included are areas of Clovis loamy sand, 0 to 8 percent slopes, that make up about 1 percent.

Runoff is slow, and the hazard of erosion is slight. This soil is used for range and wildlife habitat. Capability unit VIs–1, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Hubert gravelly loam, 2 to 15 percent slopes, eroded (HUC2).—This soil is on ridge crests, low hills, and short, convex side slopes of local drainageways. It has a profile similar to the one described as representative of the series, but most of the original surface layer has been removed by both sheet and gully erosion. On the steeper slopes, small areas of the very gravelly, calcareous substratum are exposed. Slopes generally are 5 to 15 percent. Included in mapping are areas of Rough broken land that make up about 10 percent of the acreage and areas of Hubert gravelly loam, 0 to 8 percent slopes, that make up 5 percent.

Runoff is rapid, and the hazard of erosion is high. This soil is used for range and wildlife habitat. Capability class VIe–1, dryland; Loamy Upland range site, 12 to 16 inches precipitation.

Jocity Series

The Jocity series consists of well-drained soils that formed in alluvium derived mainly from shale and shaly sandstone. These soils are on alluvial fans and flood plains. Slopes are smooth and slightly convex. They generally are 0 to 3 percent but, in small areas on the fans, are as much as 6 percent. Elevations range from 5,400 to 6,000 feet. The average annual precipitation is 8 to 12 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 120 to 140 days. The vegetation is blue grama, galleta, alkali sacaton, and chamiza.

In a representative profile, the surface layer is reddish-gray sandy clay loam about 7 inches thick. The underlying material, to a depth of about 40 inches, is reddish-gray sandy clay loam. Below this, the material is light-gray sandy clay loam that extends to a depth of 70 inches. The soil is calcareous and moderately alkaline throughout.

Permeability is moderately slow, and the available water capacity is high. The effective root depth is more than 5 feet.

Jocity soils are used chiefly for range and wildlife habitat. In the vicinity of Hunt, these soils are farmed to irrigated corn or sorghum for silage, alfalfa, small grains, and pasture.

Representative profile of Jocity sandy clay loam, about 6 miles southeast of the Petrified Forest National Park, about 960 feet southwest of the stock tank in the SE¼NW¼ sec. 17, T. 15 N., R. 24 E.

A1—0 to 7 inches, reddish-gray (5YR 5/2) sandy clay loam, dark reddish gray (5YR 4/2) moist; weak, medium and coarse, granular structure; slightly hard when dry, very friable when moist, slightly sticky and plastic when wet; many very fine roots and few fine roots; common, very fine, tubular and interstitial pores; slightly effervescent; moderately alkaline; clear, smooth boundary.

C1—7 to 21 inches, reddish-gray (5YR 5/2) sandy clay loam, dark reddish gray (5YR 4/2) moist; massive; hard when dry, friable when moist, sticky and plastic when wet; many very fine roots and few fine roots; common, fine, tubular pores; strongly effervescent; moderately alkaline; gradual, smooth boundary.

C2—21 to 40 inches, reddish-gray (5YR 5/2) sandy clay loam, dark reddish gray (5YR 4/2) moist; massive; very hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; common, fine, tubular pores; strongly effervescent; moderately alkaline; gradual, smooth boundary.

C3—40 to 70 inches, light-gray (5YR 6/1) sandy clay loam, dark gray (5YR 4/1) moist; massive; hard when dry, friable when moist, sticky and plastic when wet; few very fine roots; few, very fine, tubular and interstitial pores; strongly effervescent; moderately alkaline.

The A horizon ranges from 5YR to 7.5YR in hue, is 1 to 3 in chroma, and is 5 or 6 in value when dry and 4 or 5 when moist. It has weak, thick, platy structure or moderate or weak, granular. The C horizon generally is 5YR in hue but ranges to 7.5YR; it ranges from 1 to 3 in chroma and is 5 to 7 in value when dry and 5 or 6 when moist.

Jocity sandy loam, 0 to 3 percent slopes (JoB).—This soil is on narrow fans and flood plains. It has a profile similar to the one described as representative of the series, but the surface layer is reddish-brown sandy loam. Elevations range from 5,400 to 5,700 feet, the average annual precipitation is 10 to 12 inches, and the frost-free season is 158 to 170 days. Included in mapping are local saline areas. These areas are shown on the detailed soil map by a symbol for saline or alkali spot.

Runoff is medium, and the hazards of erosion and soil blowing are moderate. Some overwashes of short duration may occur in local areas. This soil is used for range and irrigated farming. Crops are alfalfa, sorghum or corn for silage, small grains, and pasture. Capability units IIe–2, irrigated, and VIe–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Jocity sandy clay loam (JR).—This soil is on broad, extensive alluvial fans and flood plains. It has the profile described as representative of the series. Slopes generally are 0 to 3 percent but, in small areas on the fans, are as much as 6 percent.

Runoff is medium, and the hazard of erosion is moderate. Some minor overflow of short duration occurs from side drainageways. This soil is used for range and wildlife habitat. Capability unit VIe–1, dryland; Clay Fans range site, 8 to 12 inches precipitation.

Jocity-Claysprings complex (JS).—This mapping unit is about 60 percent Jocity sandy clay loam and 25 percent Claysprings clay. These soils occur together in intricate patterns. They are undulating and are on broad fans of alluvium that is underlain by shale. Slopes are complex and short; they generally are 1 to 3 percent but range from 0 to 8 percent. The Jocity soil is on hummocks, and the Claysprings soil and shale outcrops are between the hummocks.

Included with these soils in mapping are areas of shale outcrops that make up about 10 percent of the total acreage. Also included, adjacent to the drainageways, are small dunes of Sheppard loamy sand, 0 to 8 percent slopes. This included soil makes up about 5 percent of the acreage.

Runoff is medium, and the hazard of erosion is moderate. A typical area of this mapping unit is in the SW¼ of sec. 33, T. 16 N., R. 26 E. The vegetation on the Jocity and Sheppard soils is mainly blue grama, galleta, and chamiza. The Claysprings soil is nearly barren.

These soils are used for range and wildlife habitat. Capability unit VIe–1, dryland; Clay Fans range site, 8 to 12 inches precipitation.

Loamy Alluvial Land

Loamy alluvial land (lO) consists of light-colored, deep, well-drained, calcareous, highly stratified soil material that is of variable texture but is dominantly clay loam. Texture ranges from sandy loam to clay, in no set pattern or thickness of strata. This land type is on flood plains. Slopes are mainly 0 to 3 percent. The stream channels in many places are entrenched to a depth of 6 feet or more. Elevations range from 6,000 to 6,700 feet. The average annual precipitation is 10 to 14 inches, the average annual temperature is 49° to 52° F., and the frost-free season is 140 to 158 days.

Included with this land in mapping are areas of Jocity sandy clay loam that make up about 5 percent of this unit and areas of Tours clay loam that make up about 5 percent.

Permeability is moderately slow, and the available water capacity is high. Runoff is medium. The hazard of erosion is moderate. Overflow of short duration from side drainageways occurs about once every 5 years in localized areas.

This land type is used for range and wildlife habitat. The vegetation is a sparse stand of chamiza, alkali saca-

ton, and blue grama. In areas that receive extra runoff water, the vegetation is dense. Capability unit VIe–1, dryland; Loam Bottoms range site, 16 to 24 inches precipitation.

Luth Series

The Luth series consists of poorly drained soils that formed in alluvium derived from basic tuff. These soils are on narrow flood plains of mountain valleys. Slopes are 1 to 3 percent. Elevations range from 7,700 to 8,500 feet. The average annual precipitation is 14 to 25 inches, the average annual temperature is 43° to 45° F., and the frost-free season is 80 to 90 days. The vegetation is mainly western wheatgrass, squirreltail, sedges, and iris.

In a representative profile, the surface layer is very dark gray clay loam and clay about 18 inches thick. The underlying material is dark grayish-brown clay loam to a depth of 27 inches, pale-olive clay loam between depths of 27 and about 37 inches, and light brownish-gray gravelly sandy loam to a depth of 60 inches. The soil is slightly acid in the surface layer and mildly alkaline to moderately alkaline in the underlying material.

Permeability is slow, and the available water capacity is high. The effective root depth is more than 5 feet.

Luth soils are used for range, wildlife habitat, and watershed and are farmed to small grains for hay and pasture.

Representative profile of Luth clay loam, seeped, 1 to 3 percent slopes, about 1 mile east of Alpine, about 100 feet north of the highway, approximately at the east quarter corner of sec. 18, T. 5 N., R. 31 E.

A11—0 to 1 inch, very dark gray (10YR 3/1) clay loam, black (10YR 2/1) moist; moderate, very fine and fine, granular structure; hard when dry, friable when moist, very sticky and very plastic when wet; many very fine and fine roots; many, very fine and fine, tubular pores and few, medium, tubular pores; slightly acid; abrupt, smooth boundary.

A12—1 inch to 8 inches, very dark gray (10YR 3/1) clay loam, black (10YR 2/1) moist; weak, thick, platy structure parting to strong, medium, platy; hard when dry, friable when moist, very sticky and very plastic when wet; many very fine roots and few fine roots; many, very fine, tubular pores and few, fine, tubular pores; slightly acid; clear, smooth boundary.

A13—8 to 18 inches, very dark gray (10YR 3/1) clay, very dark gray (10YR 3/1) moist; moderate, coarse, prismatic structure parting to moderate, medium, angular blocky; very hard when dry, firm when moist, very sticky and very plastic when wet; common very fine roots; many, very fine, tubular pores and few, medium and coarse, tubular pores; slightly acid; gradual, wavy boundary.

C1gca—18 to 27 inches, dark grayish brown (2.5YR 4/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; many, fine and medium, reddish-brown and yellowish-brown iron mottles and many, dark-brown, organic stains on ped faces; moderate, medium, prismatic structure parting to moderate, coarse, subangular blocky; very hard when dry, firm when moist, very sticky and very plastic when wet; few very fine roots; common, very fine, tubular and interstitial pores; thick pressure faces on peds; noneffervescent in matrix but strongly calcareous in few, fine and medium segregations of white, soft lime; mildly alkaline; gradual, smooth boundary.

C2gca—27 to 37 inches, pale-olive (5Y 6/3) clay loam, olive (5Y 5/3) moist; common, medium, distinct, olive (5Y 5/6) iron mottles; moderate, medium, prismatic structure parting to weak, medium, subangular blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; few very fine roots; common, very fine, tubular and interstitial pores; thick pressure faces on peds; noneffervescent in matrix but strongly calcareous where few, fine and medium segregations of white, soft lime occur; moderately alkaline; clear, smooth boundary.

IIC3g—37 to 60 inches, light brownish-gray (2.5Y 6/2) gravelly sandy loam, light olive brown (2.5Y 5/4) moist; many, fine, distinct, yellow and gray iron mottles; massive; hard when dry, friable when moist, sticky and slightly plastic when wet; few very fine roots; many, fine and very fine, interstitial pores; 35 percent gravel; moderately alkaline.

Depth to the Cg horizon ranges from about 10 inches to about 20 inches.

Luth soils in this survey area are more poorly drained than is defined for the Luth series, but this difference does not greatly affect the use and management of the soils.

Luth clay loam, seeped, 0 to 1 percent slopes (LuA).—This soil is on long, narrow flood plains of mountain valleys.

Runoff is very slow, and the hazard of erosion is slight. This soil is frequently wet to the surface during the growing season. It is used mainly for pasture. If drained, it is suitable for pasturing and limited cropping. Capability unit IVw–8, irrigated; Meadow range site, 12 to 25 inches precipitation.

Luth clay loam, seeped, 1 to 3 percent slopes (LuB).—This soil is on long, narrow flood plains of mountain valleys. It has the profile described as representative of the series. Included in mapping are small areas where slopes are as steep as 5 percent. Also included are small areas of soils that are better drained than this one and are not mottled.

Runoff is slow, and the hazard of erosion is slight. During July and August the water table is 0 to 2 feet from the surface, but in May it may be as deep as 6 feet. This soil is used for range and watershed and is farmed to small grains and grasses for hay and pasture. Capability unit IVw–8, irrigated; Meadow range site, 12 to 25 inches precipitation.

Millett Series

The Millett series consists of well-drained soils that formed in gravelly alluvium derived mainly from quartzite and sandstone. These soils are on hills and terrace breaks. Slopes are short; they generally are 8 to 20 percent but range to as much as 30 percent. Elevations range from 5,500 to 7,000 feet. The average annual precipitation is 10 to 16 inches, the average annual temperature is 50° to 55° F., and the frost-free season is 130 to 140 days. The vegetation is mainly blue grama, black grama, galleta, Indian ricegrass, chamiza, and Mormon tea. In addition, there are scattered juniper trees.

In a representative profile, the surface layer is reddish-brown gravelly sandy loam about 2 inches thick. The subsoil is reddish-brown gravelly sandy clay loam and clay loam about 6 inches thick. The underlying material, to a depth of about 18 inches, is pinkish-gray gravelly loam. Below this, the material is reddish-brown very gravelly light sandy clay loam that extends to a depth of 60 inches or more. The soil is calcareous and moderately alkaline throughout.

Permeability is moderate, and the available water capacity is low. The effective root depth is more than 60 inches.

Millett soils are used chiefly for range and wildlife habitat. Gravel and material for road fill are obtained from the substratum of these soils in select locations.

Representative profile of Millett gravelly sandy loam, 8 to 30 percent slopes, 8 miles northwest of Concho, in the NE¼ sec. 5, T. 13 N., R. 25 E., approximately 10 feet north of the road and 0.9 mile west of the windmill.

A1—0 to 2 inches, reddish-brown (5YR 4/3) gravelly sandy loam, dark reddish brown (5YR 3/3) moist; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; few fine roots; many, fine, interstitial pores; 20 percent gravel; slightly effervescent; moderately alkaline; clear, smooth boundary.

B21t—2 to 4 inches, reddish-brown (5YR 4/4) gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine roots; common, fine, tubular and interstitial pores; few thin clay films on ped faces and in pores; 15 percent gravel; slightly effervescent; moderately alkaline; clear, wavy boundary.

B22ca—4 to 8 inches, reddish-brown (5YR 5/4) light clay loam, dark reddish brown (5YR 3/4) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common, fine, tubular and interstitial pores; 10 percent gravel; strongly effervescent; moderately alkaline; clear, wavy boundary.

IIC1ca—8 to 18 inches, pinkish-gray (5YR 7/2) gravelly loam, light reddish brown (5YR 6/4) moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; few, fine, tubular pores; 25 percent gravel; violently effervescent; many, medium, pinkish-white (5YR 8/2), soft lime masses; moderately alkaline; clear, wavy boundary.

IIC2ca—18 to 60 inches, reddish-brown (5YR 5/4) very gravelly light sandy clay loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard when dry, friable when moist, sticky and plastic when wet; few, fine, tubular pores; 55 percent gravel; violently effervescent; many, large, pinkish-white (5YR 8/2), soft lime masses; moderately alkaline.

The solum is less than 20 inches thick. The A horizon is 5YR or 7.5YR in hue, 3 or 4 in chroma, and 4 or 5 in value when dry and 3 or 4 when moist. The B horizon is 10 to 35 percent gravel by volume. The upper part of the B horizon has slight efferverscence in places. The C horizon is 5YR or 7.5YR in hue, 2 to 4 in chroma, and 5 to 7 in value when dry and 3 to 6 when moist. It is mainly gravelly loam, gravelly sandy loam, very gravelly sandy loam, and very gravelly sandy clay loam.

Millett gravelly sandy loam, 8 to 30 percent slopes (MGD).—This soil is on low hills and long, narrow terrace escarpments. Included with it in mapping, generally where the slopes are steeper, are areas of a soil that is underlain by clayey shale at a depth of about 6 inches. This included soil makes up about 8 percent of the total acreage. Also included, commonly near the base of slopes, are areas of a soil that has a dark-colored surface layer 10 inches thick. This soil makes up about 20 percent of the acreage. Other inclusions are areas of Rough broken land that make up about 10 percent.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range and wildlife habitat.

Areas of this soil that are in the west-central part of the survey area, where elevations are mainly lower and the average annual precipitation is 10 to 12 inches, support a plant cover that is dominantly black grama, Indian ricegrass, wolftail, and needle-and-thread. Other areas of this soil, where the average annual precipitation is 12 to 13 inches, support black grama, Indian ricegrass, sand bluestem, and little bluestem under an open stand of juniper and pinion pine having a canopy of 15 to 20 percent. Capability unit VIe–1, dryland; Loamy Upland range site, 8 to 12 inches precipitation, and Loamy Upland range site, 12 to 16 inches precipitation.

Moenkopie Series

The Moenkopie series consists of well-drained soils that formed in material that weathered from hard sandstone on hills and broad plains. Slopes generally are 1 to 15 percent but range from 0 to 30 percent. Elevations range from 5,400 to 6,500 feet. The average annual precipitation is 8 to 12 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 130 to 140 days. The vegetation is a sparse to moderate stand of juniper and blue grama, galleta, black grama, sand dropseed, snakeweed, and rabbitbrush.

In a representative profile, the surface layer is reddish-brown loamy sand about 2 inches thick. The underlying material is reddish-brown sandy loam that is about 7 inches thick and is underlain by hard sandstone. The soil is calcareous and moderately alkaline throughout.

Permeability is moderately rapid, and the available water capacity is low. The effective root depth is 5 to 20 inches.

Moenkopie soils are used for range and wildlife habitat.

Representative profile of Moenkopie loamy sand, 0 to 8 percent slopes, about 5 miles north of Concho, 65 feet south of milepost 349 on the west side of U.S. Highway 180, in the SW¼NE¼ sec. 7, T. 13 N., R. 26 E.

A1—0 to 2 inches, reddish-brown (5YR 4/3) loamy sand, dark reddish brown (5YR 3/4) moist; weak, medium, platy structure and weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; common fine roots; common, very fine, interstitial pores; violently effervescent; moderately alkaline; abrupt, smooth boundary.

C—2 to 9 inches, reddish-brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; common fine roots; few, fine and very fine, tubular pores; violently effervescent; moderately alkaline; clear, smooth boundary.

R—9 to 13 inches, reddish-brown (5YR 5/3) and reddish-gray (5YR 5/2) very hard sandstone, dark reddish brown (5YR 3/3 and 3/2) moist; violently effervescent; moderately alkaline.

Depth to bedrock is mainly 9 to 18 inches but ranges from 5 to 20 inches. The A horizon ranges from 7.5YR to 2.5YR in hue, from 3 to 6 in chroma, and from 4 to 6 in value when dry and 3 or 4 when moist. The C horizon is 5YR or 2.5YR in hue, 3 to 6 in chroma, and 5 or 4 in value when dry. It is fine sandy loam or sandy loam, and it is gravelly in some places.

Moenkopie loamy sand, 0 to 8 percent slopes (MKB).—This soil is on hills and broad plains. It has the profile described as representative of the series. Included in mapping are areas of Moenkopie very rocky loamy sand, 0 to 30 percent slopes, that make up about 4 percent of the acreage and areas of Tours loam that make up about 1 percent.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range and wildlife habitat. Capability unit VIIs–1, dryland; Shallow Upland range site, 8 to 12 inches precipitation.

Moenkopie very rocky loamy sand, 0 to 30 percent slopes (MOD).—This soil is on plains or hills and escarpments. It has a profile similar to the one described as representative of the series, but depth to bedrock is mainly 5 to 8 inches. Areas of Moenkopie loamy sand make up about 60 percent of the acreage, and areas of outcrops of red sandstone make up about 39 percent. Included in mapping, in long, narrow drainageways, are areas of Tours loam that make up about 1 percent of the acreage.

Runoff is rapid, and the hazard of erosion is moderate. This soil is used for range and wildlife habitat. Capability unit VIIs–1, dryland; Shallow Upland range site, 8 to 12 inches precipitation.

Navajo Series

The Navajo series consists of well-drained soils that formed in alluvium derived from shale, sandstone, and basalt. These soils are on broad flood plains and alluvial fans. Slopes generally are 0 to 1 percent but range to as much as 5 percent. Elevations range from 5,400 to 6,000 feet. The average annual precipitation is 8 to 12 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 120 to 140 days. The vegetation is a sparse cover of alkali sacaton and chamiza.

In a representative profile, the soil is weak-red clay that extends to a depth of 72 inches. It is moderately alkaline and calcareous throughout.

Permeability is very slow, and the available water capacity is high in most places and moderate where affected by salt and alkali. The effective root depth is more than 5 feet.

Navajo soils are used for range, wildlife habitat, and irrigated farming. Most of the farming is in the vicinity of Hunt. Sorghum or corn for silage, alfalfa, small grains, and pasture are the main crops.

Representative profile of Navajo clay, about 14 miles northwest of Concho, 1,300 feet north of the bridge across the Little Colorado River, on U.S. Highway 180, near the east quarter corner of sec. 33, T. 15 N., R. 25 E.

A1—0 to 24 inches, weak-red (2.5YR 5/2) clay, reddish brown (2.5YR 4/4) moist; massive; very hard when dry, firm when moist, very sticky and very plastic when wet; few fine and very fine roots; few, very fine and fine, tubular pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

C1—24 to 44 inches, weak-red (2.5YR 5/2) clay, reddish brown (2.5YR 5/4) moist; moderate, medium, platy structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few fine and very fine roots; few, very fine and fine, tubular pores; few crystals of white salt and gypsum; very strongly effervescent; moderately alkaline; clear, smooth boundary.

C2—44 to 72 inches, weak-red (2.5YR 5/2) clay, reddish brown (2.5YR 4/4) moist; massive; extremely hard when dry, firm when moist, very sticky and very plastic when wet; few very fine roots; few slickensides and pressure faces; few fine crystals of white salt and gypsum; strongly effervescent; moderately alkaline.

A few thin strata of slightly coarser textured material occur in some places. Filaments and soft segregations of lime are abundant in places. The content of soluble salts and exchangeable sodium is variable. The profile ranges from nonsaline and nonalkali to saline-alkali. The A horizon ranges from 2 to 6 in chroma and is 3 to 6 in value when dry and 4 or 5 when moist. The C horizon ranges from 2.5YR to 5YR in hue, 2 to 6 in chroma, and 4 to 6 in value when dry and 3 to 5 when moist.

Navajo sandy clay loam, 1 to 3 percent slopes (NaB).—This soil is on broad alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is sandy clay loam about 5 to 8 inches thick. It is not salt and alkali affected. Included in mapping are areas of Tours clay loam that make up 10 percent of the acreage.

Runoff is medium, and the hazard of erosion is moderate. This soil is used mainly for range and wildlife habitat. In a few places where water is available for irrigation, it is used for pasture. Capability units IIIe–8, irrigated, and VIs–1, dryland; Clay Bottoms range site, 10 to 14 inches precipitation.

Navajo sandy clay loam, 3 to 5 percent slopes (NaC).—This soil is on broad alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is sandy clay loam about 5 to 8 inches thick. It is not salt and alkali affected. Included in mapping are small areas where the surface layer is gravelly.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, wildlife habitat, and irrigated crops, such as alfalfa, pasture, and small grains. Capability units IIIe–8, irrigated, and VIe–1, dryland; Clay Bottoms range site, 10 to 14 inches precipitation.

Navajo clay (NC).—This soil is mainly on broad, smooth flood plains but, in a few places, is on wind-laid clay hummocks. It has the profile described as representative of the series. It is not salt and alkali affected. Slopes generally are 0 to 3 percent but in places are as much as 4 percent. Included in mapping, near the side drainageways, are areas of Tours clay loam that make up about 1 percent of the acreage. Also included are localized areas that are subject to occasional overflow from side drainageways and along the main drainageways. In the area of Hunt, there are small included areas of steep clay dunes that are nearly barren and are subject to severe soil blowing.

Runoff is slow, and the hazard of erosion is slight. This soil is used for range and wildlife habitat. Capability unit VIs–1, dryland; Clay Bottoms range site, 10 to 14 inches precipitation.

Navajo clay, 0 to 1 percent slopes (NdA).—This soil is on flood plains. In places the surface is hummocky. This soil is not salt and alkali affected. Included in mapping are localized areas that are subject to occasional overflow from side drainageways and along the main drainageways.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil is used mainly for range and wildlife habitat, but in some areas it is used for irrigated alfalfa, pasture, sorghum or corn for silage, and small grains. Capability units IIIe–3, irrigated, and VIs–1, dryland; Clay Bottoms range site, 10 to 14 inches precipitation.

Navajo clay, 1 to 3 percent slopes (NdB).—This soil is on flood plains and alluvial fans. It is not salt or alkali affected.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, for wildlife habitat, and, in some areas, for irrigated alfalfa, pasture, small grains, and sorghum or corn for silage. Capability units IIIe–3, irrigated, and VIs–1, dryland; Clay Bottoms range site, 10 to 14 inches precipitation.

Navajo clay, 3 to 5 percent slopes (NdC).—This soil is on alluvial fans. It is not salt and alkali affected.

Runoff is medium, and the hazards of erosion and soil blowing are moderate. This soil is used for range, for wildlife habitat, and, in some areas, for irrigated alfalfa, pasture, small grains, and sorghum or corn for silage. Capability units IIIe–3, irrigated, and VIe–1, dryland; Clay Bottoms range site, 10 to 14 inches precipitation.

Navajo clay, saline-alkali, 0 to 1 percent slopes (NlA).—This nearly level and hummocky soil is on broad flood plains. It has a profile similar to the one described as representative of the series, but it is salt and alkali affected and consequently has only moderate available water capacity. Included in mapping are areas that are subject to overflow from side drainageways and flooding along the main drainageways.

Runoff is slow, and the hazard of erosion is slight. This soil is used for range and wildlife habitat. Capability unit VIIs–2, dryland; Saline Bottoms range site, 8 to 12 inches precipitation.

Nutrioso Series

The Nutrioso series consists of well-drained soils that formed in alluvium derived from volcanic tuff and basalt. These soils are on flood plains and alluvial fans. Slopes generally are 1 to 3 percent but range from 0 to 5 percent. Elevations range from 6,900 to 8,000 feet. The average annual precipitation is 13 to 16 inches, the average annual temperature is 43° to 47° F., and the frost-free season is 90 to 120 days. The vegetation is blue grama, sand dropseed, western wheatgrass, and vine-mesquite.

In a representative profile, the surface layer is dark-gray loam about 17 inches thick. The underlying material is light-gray silt loam to a depth of about 36 inches, dark-gray clay loam between depths of 36 and about 44 inches, and gray sandy loam to a depth of 60 inches or more. The soil is moderately alkaline throughout.

Permeability is moderately slow, and the available water capacity is high. The effective root depth is more than 5 feet.

Nutrioso soils are used for range, wildlife habitat, watershed, and irrigated farming. Crops grown are alfalfa, corn or sorghum for silage, small grains, and pasture.

Representative profile of Nutrioso loam, 1 to 3 percent slopes, about 11 miles southeast of Springerville, 1,320 feet north and 660 feet west of the center of sec. 9, T. 7 N., R. 30 E.

A11—0 to 5 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate, medium, platy structure; slightly hard when dry, friable when moist, sticky and plastic when wet; common fine roots and many very fine roots; many, very fine, interstitial pores; slightly effervescent in places, noneffervescent elsewhere; moderately alkaline; abrupt, smooth boundary.

A12—5 to 17 inches, dark-gray (10YR 4/1) heavy loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common fine roots and many very fine roots; common, very fine, tubular pores; moderately alkaline; abrupt, smooth boundary.

C1—17 to 36 inches, light-gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; few, medium, distinct, reddish-brown and yellowish-brown, relict iron mottles; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; many, very fine, tubular pores and few to common, fine, tubular pores; slightly effervescent; moderately alkaline; abrupt, smooth boundary.

C2—36 to 44 inches, dark-gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; few, medium, faint, reddish-brown, relict iron mottles; massive; very hard when dry, friable when moist, sticky and very plastic when wet; few very fine roots; many, very fine, tubular pores, few, fine, tubular pores, and common, medium, tubular pores; moderately alkaline; abrupt, smooth boundary.

C3—44 to 60 inches, gray (10YR 5/1) sandy loam, dark gray (10YR 4/1) moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; very few very fine and fine roots; few, fine, tubular pores and common, medium, tubular pores; moderately alkaline.

The soil is mildly alkaline to moderately alkaline and ranges from noneffervescent in some horizons to violently effervescent in others. Iron mottles are relict, and the C horizon in places is free of iron mottles. The A horizon is 10YR or 7.5YR in hue, 1 or 2 in chroma, and 4 or 5 in value when dry and 2 or 3 when moist. The C horizon is 10YR or 7.5YR in hue and 1 or 2 in chroma.

Nutrioso loam (NT).—This soil is on flood plains and alluvial fans that are as much as one-half mile across. It has a profile similar to the one described as representative of the series, but on the fans it does not have the variations in color that result from stratification. The frost-free season is 110 to 120 days. Slopes generally are 0 to 3 percent but range to as much as 5 percent.

Runoff is slow, and the hazard of erosion is slight. The hazard of flooding is slight (once in every 10 to 100 years) along the main drainageway. This soil is used for range, wildlife habitat, and watershed. Capability unit VIc–1, dryland; Loam Bottoms range site, 16 to 24 inches precipitation.

Nutrioso loam, 0 to 1 percent slopes (NuA).—This soil is on flood plains along Nutrioso Creek and the Little Colorado River. Included with it in mapping, west of Nutrioso and along the Little Colorado River southwest of Springerville, are somewhat poorly drained areas where the water table fluctuates between 2 and 5 feet from the surface. Also included, west of Eagar, are small areas where the soil is gravelly below a depth of 3 feet.

Runoff is slow, and the hazard of erosion is slight. The hazard of flooding is slight along the main drainageways. This soil is used for range, wildlife habitat, watershed, and irrigated farming. Crops grown are alfalfa, sorghum or corn for silage, small grains, and pasture. Capability units IIIe–1, irrigated, and VIc–1, dryland; Loam Bottoms range site, 16 to 24 inches precipitation.

Nutrioso loam, 1 to 3 percent slopes (NuB).—This soil is on flood plains and fans along Nutrioso Creek and the Little Colorado River. It has the profile described as representative of the series. Included in mapping, in the vicinity of Nutrioso, are small areas that are somewhat poorly drained and have a water table between 2 feet and 5 feet from the surface. Also included, southeast of Eagar, are large areas of a soil that is on a fan and is loam throughout. On the flood plains west of Eagar, there is a small included area where the soil is gravelly below a depth of 3 feet.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, wildlife habitat, watershed, and irrigated farming. Crops grown are alfalfa, sorghum or corn for silage, small grains, and pasture. Small areas in the vicinity of Alpine are used for housing. Capability units IIIe–1, irrigated, and VIc–1, dry-

land; Loam Bottoms range site, 16 to 24 inches precipitation.

Nutrioso loam, 3 to 5 percent slopes (NuC).—This soil is on narrow alluvial fans and flood plains. It has a profile similar to the one described as representative of the series, but it is mainly loam throughout. Included in mapping, on very narrow flood plains adjacent to Nutrioso Creek, are small areas that are somewhat poorly drained, have a water table 3 to 5 feet from the surface, and are subject to annual overflow.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, wildlife habitat, watershed, and irrigated farming. Crops grown are alfalfa, silage crops, small grains, and pasture. Some areas, especially near Alpine, are used for housing. Capability units IIIe–1, irrigated, and VIe–1, dryland; Loam Bottoms range site, 16 to 24 inches precipitation.

Palma Series

The Palma series consists of well-drained soils that formed in eolian sand and sandy alluvium derived from quartzite, gneiss, schist, sandstone, and limestone. These soils are on low, dunelike ridges and broad, undulating plains. Slopes generally are 1 to 4 percent but range from 0 to 8 percent. Elevations range from 5,400 to 7,000 feet. The average annual precipitation is 8 to 13 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 130 to 140 days. The vegetation is mainly needle-and-thread, blue grama, galleta, Indian ricegrass, chamiza, winterfat, rabbitbrush, and a sparse to moderate stand of juniper.

In a representative profile, the surface layer is brown loamy sand about 3 inches thick. The subsoil is reddish-brown sandy loam and brown fine sandy loam about 18 inches thick. The underlying material, to a depth of about 41 inches, is light-brown fine sandy loam. Below this, the material is reddish-brown sandy clay loam that extends to a depth of 60 inches or more. The soil is moderately alkaline to a depth of 5 inches, neutral between depths of 5 and 12 inches, and moderately alkaline from a depth of 12 inches to more than 60 inches. A zone of lime accumulation is at a depth of 21 inches.

Permeability is moderate, and the available water capacity is moderate. The effective root depth is more than 5 feet.

Palma soils are used for range and wildlife habitat.

Representative profile of Palma loamy sand, 0 to 8 percent slopes, about 16 miles north of Saint Johns, 1,300 feet south and 130 feet west of the center of sec. 4, T. 15 N., R. 29 E. (See table 7 for laboratory data.)

A1—0 to 3 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; weak, medium and thick, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine and medium roots; few, fine and medium, tubular pores; moderately alkaline; abrupt; smooth boundary.

B1—3 to 5 inches, reddish-brown (5YR 4/4) light sandy loam, reddish brown (5YR 4/4) moist; weak, medium and coarse, subangular blocky structure; hard when dry, friable when moist, nonsticky and nonplastic when wet; common fine and medium roots; many, fine, interstitial pores and common, fine, tubular pores; moderately alkaline; clear, smooth boundary.

B2t—5 to 12 inches, reddish-brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4) moist; weak, coarse, prismatic structure parting to weak, medium and coarse, subangular blocky; hard when dry, friable when moist, nonsticky and slightly plastic when wet; common fine and medium roots; common, fine, interstitial pores and common, fine and medium, tubular pores; common thin clay films on ped faces, as bridges between sand grains, and in pores; neutral; clear, smooth boundary.

B3—12 to 21 inches, brown (7.5YR 5/4) light fine sandy loam, dark brown (7.5YR 4/4) moist; massive; hard when dry, friable when moist, nonsticky and nonplastic when wet; few fine, medium, and coarse roots; few, fine and medium, tubular pores; moderately alkaline; clear, smooth boundary.

Cca—21 to 41 inches, light-brown (7.5YR 6/4) fine sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; few fine, medium, and coarse roots; many, fine, interstitial pores; strongly effervescent; common fine and medium filaments and veins of white (N 8/0) lime; clear, smooth boundary.

IIB21cab—41 to 54 inches, reddish-brown (5YR 5/4) light sandy clay loam, reddish brown (5YR 4/4) moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; few, fine, tubular pores and common, fine, interstitial pores; strongly and violently effervescent; many fine and medium filaments of white (N 8/0) lime and few soft masses of lime; moderately alkaline; clear, smooth boundary.

IIB22b—54 to 60 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; few, fine, tubular pores and common, fine, interstitial pores; violently effervescent; moderately alkaline.

The solum ranges from 12 to 40 inches in thickness and from neutral to moderately alkaline in reaction. The A horizon ranges from 10YR to 5YR in hue, ranges from 2 to 4 in chroma, and is 5 or 6 in value when dry and 4 or 5 when moist. The B2 horizon is 5YR or 2.5YR in hue, 3 to 5 in chroma, and 4 to 6 in value when dry and 3 to 5 when moist. The C horizon is 5YR or 7.5YR in hue.

Palma loamy sand, 0 to 8 percent slopes (PAB).—This soil is mainly on low, dunelike ridges, but in a few places it is undulating on broad plains. It has the profile described as representative of the series. Slopes generally are 1 to 4 percent.

Included with this soil in mapping are areas of Fruitland sandy loam, 1 to 8 percent slopes, at the lower end of long slopes. Also included are areas of Clovis loamy sand, 0 to 8 percent slopes, that are widely distributed throughout the mapping unit. Each of these included soils makes up about 5 percent of the total acreage.

Runoff is slow. The hazard of erosion is slight, and the hazard of soil blowing is moderate.

This soil is used for range and wildlife habitat. Capability unit VIe–1, dryland; Sand Upland range site, 10 to 14 inches precipitation.

Palma-Sheppard association, undulating (PSB).—This mapping unit is about 50 percent Palma loamy sand, 0 to 8 percent slopes, and 45 percent Sheppard loamy sand, 0 to 8 percent slopes. The Palma soil is in the flats between dunes or low on the sides of dunes. Some low dunes, however, are made up entirely of the Palma soil, and here slopes are mainly 1 to 4 percent. The Sheppard soil is on larger dunes and has slopes generally of 5 to 8 percent but ranging to as much as 15 percent.

The dunes vary as much as 30 feet in relief. They are generally interconnected and occur in a series with nearly flat areas that mainly extend in a northeast-southwest

direction between the dunes. Approximately 5 percent of this mapping unit is Clovis loamy sand, 0 to 8 percent slopes, which is in flats between the dunes.

Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is moderate.

These soils are used mainly for range and wildlife habitat. Both soils in capability unit VIe–1, dryland, and Sand Upland range site, 10 to 14 inches precipitation.

Riverwash

Riverwash (RH) consists of finely stratified soil material that is subject to frequent overflow and to modification resulting from the overflow. It occurs on flood plains. Some wind reworking has deposited temporary dunes. New material is deposited and old material shifted each time the stream overflows. Slopes are 0 to 3 percent. Elevations range from 5,400 to 6,000 feet. Runoff is slow. Flooding is almost annual, and the water table is generally at or near the surface during most years. The average annual precipitation is 8 to 13 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 120 to 140 days.

Included with this land in mapping are small areas of Sheppard loamy sand, 0 to 8 percent slopes, and Tours sandy loam.

This land type is used mainly for wildlife habitat. It is nearly barren of vegetation except for scattered saltcedar, which is very sparse in all but some local areas. A few cottonwood and willow trees grow in places. Capability unit VIIIw–1, dryland; not placed in a range site.

Rough Broken Land

Rough broken land (RO) consists of shallow and very shallow soil material, mostly loam and sandy loam, over shale. It is steep on dissected terrace breaks (fig. 4), and shale outcrops are prominent. Parent materials are shales of the Chinle Formation and, in a few places, of the Moenkopi Formation. The surface of this unit generally is very gravelly in the area east of Springerville. In most places slopes are short and steep. They generally are 15 to 45 percent but range from 10 to 60 percent. Elevations range from 5,400 to 7,000 feet. Runoff is very rapid. The hazard of erosion is very high, and geologic erosion is active. The average annual precipitation is 8 to 16 inches, the average annual temperature is 48° to 55° F., and the frost-free season is 120 to 140 days.

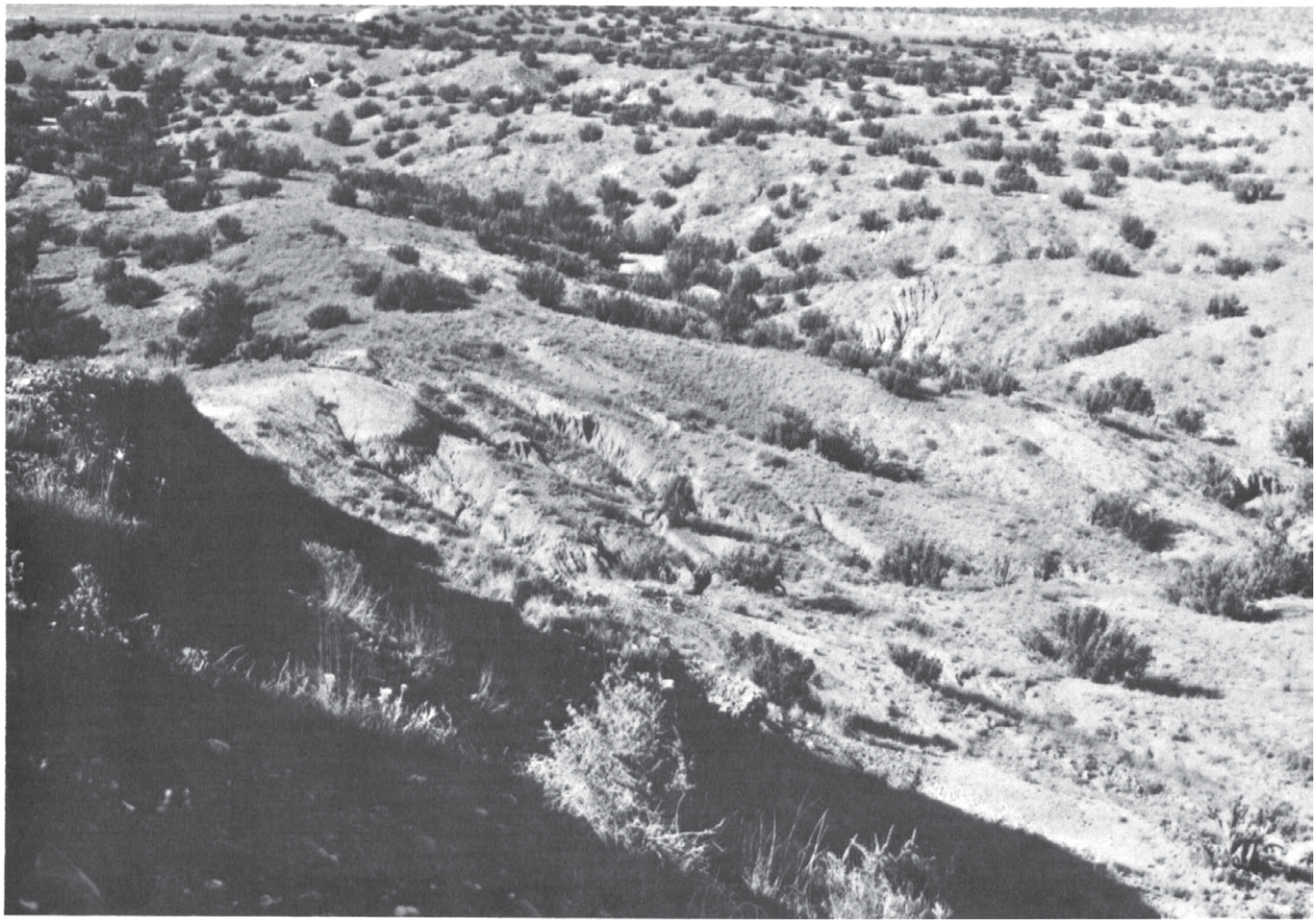

Figure 4.—An area of Rough broken land about 15 miles north of Springerville.

Included with this land in mapping are small areas of Hubert soils.

This land type is used for range and wildlife habitat. Areas at the lower elevations in the west-central part of the survey area, where the average annual precipitation is 8 to 10 inches, support a plant cover that is dominantly black grama, blue grama, and Indian ricegrass. Other areas of the mapping unit, where the precipitation is as much as 16 inches and the canopy of juniper and pinon pine is 15 to 20 percent, support a plant cover that is dominantly black grama, needle-and-thread, sand bluestem, and little bluestem and produce a total annual yield of at least 250 pounds more per acre per year. Capability unit VIIe–1, dryland; Shallow Upland range site, 8 to 12 inches precipitation, and Shallow Upland range site, 12 to 16 inches precipitation.

Rudd Series

The Rudd series consists of well-drained soils that formed on broad plains of basalt flows (fig. 5). In many places, flows of nearly the same age practically cover previous flows, and these give the landscape a terraced or benchlike appearance from a distance. Slopes generally are 3 to 8 percent but range from 0 to 45 percent. Elevations range from 6,000 to 7,500 feet. The average annual precipitation is 11 to 13 inches, the average annual temperature is 48° to 52° F., and the frost-free season is 130 to 140 days. The vegetation is mainly blue grama, black grama, and side-oats grama. Some area have a sparse stand of juniper and a few chamiza plants.

In a representative profile, the surface layer is grayish-brown and dark grayish-brown gravelly loam about 10 inches thick. This material is underlain by grayish-brown gravelly heavy loam that is about 3 inches thick and rests on basalt bedrock. This soil is calcareous and moderately alkaline throughout.

Permeability is moderate, and the available water capacity is low. The effective root depth is 6 to 20 inches.

Rudd soils are used for range, wildlife habitat, and watershed.

Representative profile of Rudd gravelly loam in an area of Rudd complex, 0 to 8 percent slopes, 5½ miles northwest of Springerville, 1,848 feet north and 396 feet east of the center of sec. 11, T. 9 N., R. 28 E. (See table 7 for laboratory data.)

Figure 5.—An area of Rudd soils east of Springerville. An accumulation of lime is above the parent basalt rock.

A11—0 to 2 inches, grayish-brown (10YR 5/2) gravelly loam, dark brown (7.5YR 3/2) moist; weak, fine, granular structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; many fine and medium roots; many, fine, interstitial pores; 40 percent coarse gravel and cobbles; strongly effervescent; moderately alkaline; clear, smooth boundary.

A12—2 to 10 inches, dark grayish-brown (10YR 4/2) gravelly heavy loam, dark brown (7.5YR 3/2) moist; weak and moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many fine and medium roots; few, fine, tubular pores and many, fine, interstitial pores; 35 percent gravel and cobbles; strongly effervescent; moderately alkaline; clear, wavy boundary.

Cca—10 to 13 inches, grayish-brown (10YR 5/2) gravelly heavy loam, dark brown (10YR 3/3) moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many fine and medium roots; many, fine, interstitial pores; 40 percent gravel and cobbles; violently effervescent; moderately alkaline; abrupt, wavy boundary.

R—13 to 24 inches, dark-gray (N 4/0) basalt bedrock, black (N 2/0) moist; massive; common fine roots matted on rock faces; white (N 8/0) lime coatings on rock surfaces and in pockets in rock fractures, pinkish-gray (7.5YR 7/2) moist.

Depth to the R horizon ranges from 6 to 20 inches. The A horizon is 10YR or 7.5YR in hue, 1 to 3 in chroma, and 4 or 5 in value when dry and 2 or 3 when moist. The profile is loam, gravelly loam, stony loam, or very stony loam. The C horizon is 10YR or 7.5YR in hue, 1 to 3 in chroma, and 5 to 7 in value when dry and 3 to 5 when moist.

Rudd loam, 1 to 3 percent slopes (RvB).—This soil is on broad plains of basalt flows. It has a profile similar to the one described as representative of the series, but depth to bedrock is about 19 inches and the upper part of the surface layer is 10 to 15 percent gravel. Some stones have been removed from the surface. Elevations range from 6,900 to 7,200 feet, and the frost-free season is 128 to 135 days.

Runoff is slow, and the hazard of erosion is slight. This soil is used mainly for range, wildlife habitat, and watershed. Capability unit VIs–1, dryland, Shallow Upland range site, 12 to 16 inches precipitation.

Rudd stony loam, 1 to 45 percent slopes (RwF).—This soil is on mesa tops and escarpments and on narrow ridges on basalt flows. It has a profile similar to the one described as representative of the series, but the surface layer contains stones and cobbles of basalt. Elevations range from 6,900 to 7,200 feet, and the frost-free season is 128 to 135 days. Included in mapping are small areas, such as Cemetery Ridge in Springerville, that are underlain by moderately lime-cemented cobbles, stones, and boulders of basalt. Also included, 1 mile south of Springerville, is an area about 300 acres in size of a soil that is similar to this Rudd soil but formed in material weathered from sandstone or shale.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, wildlife habitat, and watershed. Capability unit VIIs–1, dryland; Shallow Upland range site, 12 to 16 inches precipitation.

Rudd complex, 0 to 8 percent slopes (RXB).—This mapping unit is about 40 percent Rudd gravelly loam, 0 to 8 percent slopes, and 35 percent Rudd very stony loam, 0 to 8 percent slopes. These soils are undulating and occur in intricate patterns on plains on basalt lava flows. The vegetation is mainly blue grama, black grama, side-oats grama, and a sparse stand of juniper and some chamiza. Rudd gravelly loam in this complex has the profile described as representative of the series. It is shallow over basalt. Slopes generally are 3 to 5 percent. Rudd very stony loam has a profile similar to the one described as representative of the series, but the surface layer is very stony and the soil is very shallow and shallow over basalt. It is on long, narrow ridges and the edges of basalt flows. Slopes are convex and generally are 4 to 7 percent.

Included with these soils in mapping are areas of a soil that is similar to Rudd gravelly loam but is on vesicular basalt and cindery material that is weakly cemented with lime in the upper part and somewhat fused below. This included soil makes up about 20 percent of the acreage. About half of it occurs in large areas on the landscape, and the rest is in small areas scattered throughout the complex. Also included are areas of a moderately deep, dark-colored, loamy soil in small drainageways that make up about 1 percent of the mapping unit. Inclusions of Ziegler gravelly clay loam, 8 to 60 percent slopes, Bandera gravelly loam, 8 to 60 percent slopes, and small areas of rock outcrops along the edge of the flows and associated with Rudd very stony loam make up about 5 percent. A typical area of this complex is in sec. 36, T. 9 N., R. 29 E.

Runoff is slow, and the hazard of erosion is slight. Soils of this complex are used for range, wildlife habitat, and watershed. Capability unit VIIs–1, dryland; Shallow Upland range site, 12 to 16 inches precipitation.

Sandstone Rock Land

Sandstone rock land (SA) is on mesa caps and breaks. It is 50 percent sandstone rock and 35 percent very shallow or shallow, coarse textured or moderately coarse textured soils that are underlain by sandstone. The parent rock is of the Moenkopi, Chinle, or Dakota Formation. Slopes generally are 2 to 8 percent on the mesa caps but range to vertical on the breaks. Elevations range from 5,400 to 7,000 feet. Runoff is medium. The hazard of erosion is moderate. The average annual precipitation is 10 to 12 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 120 to 140 days.

Included with this land in mapping are areas of Rough broken land that make up about 7 percent of the total acreage, areas of Tours soils that make up about 3 percent, and areas of Badland that make up about 5 percent. In local areas, especially along the State line east of Saint Johns, Badland makes up as much as 25 percent of the mapped area.

Where accessible, this land type is used for range and wildlife habitat. The vegetation is an open stand of juniper and pinion pine and a sparse stand of blue grama, black grama, and side-oats grama. Capability unit VIIs–1, dryland; Shallow Upland range site, 8 to 12 inches precipitation.

Sandy Alluvial Land

Sandy alluvial land (SD) consists of deep, well-drained, stratified, sandy soils that formed in alluvium on broad, short flood plains and fans. A representative profile is finely stratified sand to sandy loam. The surface layer generally is loamy sand, but in some places it is sandy loam. Slopes are 1 to 3 percent. Elevations range from

5,400 to 7,000 feet. The average annual precipitation is 8 to 12 inches, the average annual temperature is 49° to 55° F., and the frost-free season is 120 to 140 days.

Included with this land in mapping are areas of Fruitland sandy loam, 1 to 8 percent slopes, and Loamy alluvial land, each of which makes up 10 percent of the total acreage. Also included are areas of Sheppard loamy sand, 0 to 8 percent slopes, that was deposited by wind along the larger drainageways and makes up 2 percent of the acreage. Included saline areas are indicated on the detailed soil map by the symbol for saline or alkali spot.

Permeability is moderately rapid, and the available water capacity is moderate. The effective root depth is more than 5 feet. Runoff is slow. The hazard of erosion is slight. This land is subject to frequent overflow and consequent sedimentation.

This land type is used mainly for range and wildlife habitat. The vegetation is blue grama, galleta, alkali sacaton, snakeweed, and a few juniper. Small areas are irrigated and farmed to alfalfa, small grains, silage crops, and pasture grasses. Capability units IIIw–7, irrigated, and VIw–2, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Shay Series

The Shay series consists of poorly drained soils that formed in alluvium derived mainly from volcanic ash and basalt. These soils are on flood plains about one-half mile wide and mostly in sloughs. Slopes are smooth, flat or slightly concave, and 0 to 1 percent. Elevations range from 6,900 to 7,000 feet. The average annual precipitation is 11 to 12 inches, the average annual temperature is 47° to 49° F., and the frost-free season is about 120 to 130 days. The vegetation is mainly a dense growth of western wheatgrass, vine-mesquite, alkali sacaton, saltgrass, and sedges. In places half of the plant cover is sedges.

In a moist representative profile, the surface layer is about 16 inches thick. It is very dark brown clay in the upper part and very dark gray clay in the lower part. The underlying material, to a depth of about 32 inches, is dark-brown and brown clay loam. Below this, the material is brown clay that extends to a depth of 60 inches. The soil is calcareous and moderately alkaline throughout.

Permeability is slow, and the available water capacity is high. The effective root depth is more than 5 feet. For about 2 months of the year, usually July and August, these soils are wet to the surface. The rest of the year the water table is about 2 feet below the surface.

Shay soils are used for range, pasture, and wildlife habitat.

Representative profile of Shay clay, on the west edge of of Springerville, about 2,000 feet southwest of the post office in the NE¼SE¼ sec. 32, T. 9 N., R. 29 E.

O—2 inches to 0, yellowish-brown (10YR 5/6 moist) mat of sedge and grass roots; strongly effervescent; clear, smooth boundary.

A11—0 to 8 inches, very dark brown (10YR 2/2 moist) clay; few, fine, distinct, light yellowish-brown (10YR 6/4) iron mottles; weak, coarse, prismatic structure; very hard when dry, very firm when moist, sticky and plastic when wet; many fine and medium roots; many, fine and medium, tubular pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

A12—8 to 16 inches, very dark gray (10YR 3/1 moist) clay; few, fine, distinct, light yellowish-brown (10YR 6/4) iron mottles; weak, medium, subangular blocky structure; very hard when dry, very firm when moist, sticky and plastic when wet; many fine and medium roots; many, fine and medium, tubular pores; strongly effervescent; moderately alkaline; gradual, smooth boundary.

C1—16 to 28 inches, dark-brown (10YR 3/3 moist) heavy clay loam; few, medium, distinct, light yellowish-brown (10YR 6/4) iron mottles; weak, medium, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; many fine and medium roots; many, fine and medium, tubular pores and few, fine, interstitial pores; 5 percent gravel; strongly effervescent; moderately alkaline; gradual, smooth boundary.

C2—28 to 32 inches, brown (7.5YR 5/4 moist) clay loam; many, fine, distinct, light yellowish-brown (10YR 6/4) iron mottles; distinct organic stains; massive; hard when dry, firm when moist, sticky and plastic when wet; few, fine, tubular and interstitial pores; 5 percent gravel; strongly effervescent; moderately alkaline; gradual, smooth boundary.

C3—32 to 60 inches, light-gray (2.5Y 7/2) clay, brown (10YR 5/3) moist; common, medium, prominent, dark reddish-gray (5YR 4/2) mottles; massive; hard when dry, firm when moist, sticky and plastic when wet; few, fine, tubular pores; 5 percent gravel; strongly effervescent; moderately alkaline.

The A horizon ranges from 10YR to 7.5YR in hue and from 1 to 3 in chroma, and it is 2 or 3 in value when moist. The C horizon ranges from 7.5YR to 5Y in hue, from 2 to 4 in chroma, and from 3 to 7 in value when moist.

Shay soils in this survey area are more poorly drained than is defined for the series, but this difference does not greatly affect the use and management of the soils.

Shay clay (Sh).—This soil is in flat or depressional areas on the flood plains of the Little Colorado River and Nutrioso Creek in the vicinity of Springerville. Included in mapping are a few small areas of Nutrioso loam, 0 to 1 percent slopes. Also included, in places north of Springerville, are areas where the soil contains salt and alkali in amounts injurious to plants and areas where the water table has been lowered to a depth of more than 5 feet. These areas are shown on the detailed soil map by the symbol for saline or alkali spot.

Runoff is ponded or very slow, and the hazard of erosion is slight. The hazard of flooding is slight along the main drainageway. The soil is used for range, pasture, and wildlife habitat. Capability unit VIw–1, irrigated; Meadow range site, 12 to 25 inches precipitation.

Sheppard Series

The Sheppard series consists of somewhat excessively drained soils that formed in eolian sand on dunes and broad, undulating plains. Slopes generally are 3 to 8 percent but range from 0 to 8 percent. Elevations range from 5,400 to 6,600 feet. The average annual precipitation is 8 to 14 inches, the average annual temperature is 52° to 55° F., and the frost-free season is 130 to 140 days. The vegetation is a sparse to moderate cover of Indian ricegrass, blue grama, sand dropseed, Mormon tea, sand sagebrush, winterfat, and juniper. The junipers vary unpredictably, occurring as widely scattered trees or in dense stands.

In a representative profile, the soil is brown loamy sand that extends to a depth of 70 inches. It is neutral in the uppermost 10 inches and moderately alkaline below.

Permeability is rapid, and the available water capacity is low. The effective root depth is more than 5 feet.

Sheppard soils are used for range and wildlife habitat.

Representative profile of Sheppard loamy sand, 0 to 8 percent slopes, about 23 miles north of Saint Johns, 100 feet north of the south quarter corner of sec. 22, T. 17 N., R. 29 E. (See table 7 for laboratory data.)

A1—0 to 10 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; single grained; loose when dry and moist, nonsticky and nonplastic when wet; common fine and medium roots; many, fine, interstitial pores; neutral; clear, smooth boundary.

C1—10 to 70 inches, brown (7.5YR 5/4) loamy sand, dark brown (7.5YR 4/4) moist; single grained; loose when dry and moist, nonsticky and nonplastic when wet; few fine, medium, and large roots; many, fine, interstitial pores; moderately alkaline.

The A and C horizons range from 10YR to 5YR in hue. The profile is noneffervescent to slightly effervescent throughout. It is loamy sand and sand in texture.

Sheppard loamy sand, 0 to 8 percent slopes (SMB).—This undulating soil is on dunes and broad plains. Slopes generally are 3 to 8 percent, but on some of the higher dunes they are slightly more than 15 percent. Although some of the dunes are as much as 30 feet high, most of them are only 10 to 15 feet high. Included in mapping are areas of Clovis loamy sand, 0 to 8 percent slopes, and Palma loamy sand, 0 to 8 percent slopes. Each of these included soils makes up about 5 percent of the total acreage. Also included, in small elongated, flat areas and swales between the dunes and undulations, are a few places where the hazard of soil blowing is moderate.

Runoff is slow. The hazard of water erosion is only slight, but the hazard of soil blowing is high. This soil is used for range and wildlife habitat.

Areas of this soil that are in the west-central part of the survey area, where elevations are lower and the average annual precipitation is 8 to 10 inches, support a plant cover that is dominantly black grama, blue grama, Indian ricegrass, needle-and-thread, and squirreltail. Other areas of this soil, where the average annual precipitation is 10 to 14 inches, support squirreltail, Indian ricegrass, needle-and-thread, and an open stand of juniper, sand sagebrush, and rabbitbrush. Capability unit VIIe–1, dryland; Sand Upland range site, 10 to 14 inches precipitation.

Springerville Series

The Springerville series consists of well-drained soils in concave areas of rolling plains that are underlain by basalt. These soils formed in residuum derived from basalt or cinders. The surface has gilgai microrelief and cracks as much as 1½ inches wide during dry periods. Slopes generally are 0 to 3 percent but range to as much as 8 percent. Elevations range from 6,000 to 7,400 feet. The average annual precipitation is 16 to 20 inches, the average annual temperature is 47° to 49°F., and the frost-free season is 120 to 140 days. The vegetation is mainly western wheatgrass, blue grama, and a few small juniper.

In a representative profile, the surface layer is dark-brown cobbly clay about 4 inches thick. The underlying material, to a depth of about 33 inches, is dark-brown cobbly clay. Below this, the material is calcareous, dark reddish-brown silty clay that is about 3 inches thick and is underlain by basalt. The soil is moderately alkaline throughout.

Permeability is very slow, and the available water capacity is moderate. The effective root depth ranges from 28 inches to more than 60 inches.

Springerville soils are used for range, wildlife habitat, and watershed.

Representative profile of Springerville cobbly clay, 0 to 8 percent slopes, about 1 mile northwest of Vernon, near the north quarter corner of sec. 16, T. 10 N., R. 25 E.

A1—0 to 4 inches, dark-brown (7.5YR 3/2) cobbly clay, dark brown (7.5YR 3/2) moist; strong, very fine, granular structure; hard when dry, friable when moist, sticky and plastic when wet; many fine and very fine roots; many, very fine, interstitial pores; 25 percent cobbles and gravel; moderately alkaline; clear, smooth boundary.

C1—4 to 33 inches, dark-brown (7.5YR 3/2) cobbly clay, dark brown (7.5YR 3/2) moist; massive; hard when dry, very firm when moist, sticky and very plastic when wet; few fine roots; few, fine, tubular pores and common, fine, interstitial pores; many slickensides; 20 percent gravel and cobbles; moderately alkaline; clear, wavy boundary.

C2ca—33 to 36 inches, dark reddish-brown (5YR 3/3) silty clay, dark reddish brown (5YR 3/4) moist; massive; very hard when dry, firm when moist, very sticky and very plastic when wet; few, fine, interstitial pores; common pressure faces and slickensides; violently effervescent; common, fine, pinkish-white (5YR 8/2) lime segregations and soft masses; moderately alkaline; clear, irregular boundary.

R—36 to 40 inches, basalt.

Depth to bedrock ranges from 28 to 70 inches. When dry, these soils have cracks that are 1 inch or more wide and 20 to 36 inches deep. Coarse fragments are pebbles, cobbles, or stones and range from few to as much as 35 percent in the A1 and C1 horizons. The soil generally is 7.5YR in hue but ranges from 5YR to 10YR; it is 2 to 4 in chroma and is 3 to 5 in value when dry and 2 to 4 when moist. The soil in places is effervescent throughout.

Springerville clay (Sp).—This nearly level soil is on broad plains over basalt flows and cinders. It is in irregularly shaped, concave areas that generally are less than one-half mile wide and, in some places, more than 2 miles long. This soil has a profile similar to the one described as representative of the series, but it does not have cobbles in the surface layer.

Runoff is slow, and the hazard of erosion is slight. This soil is used for range, wildlife habitat, and watershed. Capability unit VIs–1, dryland; Clay Upland range site, 16 to 20 precipitation.

Springerville cobbly clay, 0 to 8 percent slopes (SRB).—This soil is on broad plains over basalt flows and cinders. It is in irregularly shaped, concave areas that generally are less than one-half mile wide and, in some places, more than 2 miles long. This soil has the profile described as representative of the series. Slopes generally are 0 to 3 percent.

Runoff is slow, and the hazard of erosion is only slight, although small areas of the soil have been eroded. This soil is used for range, wildlife habitat, and watershed. Capability unit VIs–1, dryland; Clay Upland range site, 16 to 20 inches precipitation.

Stony Rock Land

Stony rock land (SU) is below the upper edge of basalt lava escarpments. Its dominant feature is the 50 to 90 percent cover of basalt boulders, stones, cobbles, and rock

outcrops. The land type is very shallow or shallow, and its characteristics are not uniform. The most consistent profile ranges from very shallow to as much as 16 inches deep and has a surface layer of cobbly loam and a subsoil of cobbly clay loam that is underlain by calcareous ash. Slopes generally are 35 to 45 percent but range from 10 to 60 percent. The lava flows, the edges of which form the escarpments, are 10 feet to more than 50 feet thick over older ash beds or soil surfaces that have been altered by heat and pressure. Some places have four or more flows of slightly different ages in vertical sequence. Elevations range from 6,000 to 7,500 feet. The average annual precipitation is 10 to 16 inches, the average annual temperature is 47° to 55° F., and the frost-free season is 120 to 140 days.

Included with this land in mapping are areas of Rudd Stony loam, 1 to 45 percent slopes, that make up 8 percent of the total acreage.

The available water capacity is low. The effective root depth is about 5 to 16 inches. Runoff is medium. The hazard of erosion is moderate.

This land type is used for range, wildlife habitat, and watershed. The vegetation is blue grama, side-oats grama, black grama, needle-and-thread, and a few scattered juniper. Capability unit VIIs–1, dryland; Shallow Upland range site, 12 to 16 inches precipitation.

Thunderbird Series

The Thunderbird series consists of well-drained soils that formed on basalt flows and cinders on broad, gently rolling plains. Slopes generally are 0 to 8 percent but range to 15 percent. Elevations are 6,000 to 7,400 feet. The average annual precipitation is 16 to 20 inches, the average annual temperature is 47° to 49° F., and the frost-free season is 130 to 140 days. The vegetation is mainly blue grama, side-oats grama, black grama, galleta, wolftail, chamiza, winterfat, and juniper. The juniper is thick in some areas.

In a representative profile, the surface layer is dark-brown cobbly clay loam about 3 inches thick. The subsoil is dark-brown clay that is about 20 inches thick and is underlain by basalt. The soil is neutral in the surface layer and moderately alkaline in the subsoil.

Permeability is very slow, and the available water capacity is low. The effective root depth is 20 to 30 inches.

Thunderbird soils are used mainly for range, wildlife habitat, and watershed. A few areas are subdivided as cabin sites.

Representative profile of Thunderbird cobbly clay loam, 0 to 15 percent slopes, about 1½ miles west of Vernon, just north of road junction, in the SE¼SW¼ sec. 17, T. 10 N., R. 25 E.

A1—0 to 3 inches, dark-brown (7.5YR 3/2) cobbly clay loam, dark brown (7.5YR 3/2) moist; strong, fine, granular structure; hard when dry, friable when moist, sticky and plastic when wet; many fine and very fine roots; common, very fine and fine, interstitial pores; 20 percent cobbles and gravel; neutral; gradual, smooth boundary.

B21t—3 to 12 inches, dark-brown (7.5YR 3/2) clay, dark brown (7.5YR 3/2) moist; moderate, fine and medium, angular blocky structure; hard when dry, very firm when moist, sticky and plastic when wet; many fine and very fine roots; few, fine, medium, and coarse, tubular and interstitial pores; common thin clay films on ped faces; 5 percent cobbles and gravel; moderately alkaline; clear, smooth boundary.

B22tca—12 to 23 inches, dark-brown (7.5YR 3/2) clay, dark brown (7.5YR 3/2) moist; moderate, medium and coarse, angular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; common very fine roots; few, fine, tubular and interstitial pores; common thin clay films on ped faces; slightly effervescent; common, fine, pinkish-white (5YR 8/2) lime segregations; moderately alkaline; abrupt, irregular boundary.

R—23 to 25 inches, basalt bedrock that has fractures filled with soil material; lime coatings on bedrock surfaces are strongly effervescent.

Depth to bedrock ranges from 20 inches to about 30 inches. Lime accumulation in many places is limited to coatings on the bedrock. The A horizon ranges from 7.5YR to 10YR in hue. The B horizon ranges from 5YR to 7.5YR in hue, and from clay to heavy clay loam in texture.

Thunderbird gravelly clay loam, 1 to 5 percent slopes (TbC).—This soil is on broad plains. It has a profile similar to the one described as representative of the series, but it does not have the high percentage of cobbles in the surface layer. Included in mapping are small areas where slopes are as much as 15 percent.

Runoff is medium, and the hazard of erosion is slight. This soil is used for range, wildlife habitat, and watershed. In the past, some small dryfarmed areas were used for silage and pasture crops.

Areas of this soil that are approximately northeast of Vernon, where elevations are less than about 7,000 feet and the average annual precipitation is between about 16 and 18 inches, support a plant cover that is dominantly side-oats grama, junegrass, western wheatgrass, and squirreltail. Other areas of this soil, where elevations are more than 7,000 feet and the average annual precipitation is 18 to 20 inches, support side-oats grama, needle-and-thread, mutton bluegrass, and junegrass under an open stand of juniper and pinon pine having a canopy of about 20 percent. Capability unit VIs–1, dryland; Clay Loam Upland range site, 16 to 20 inches precipitation.

Thunderbird cobbly clay loam, 0 to 15 percent slopes (TDB).—This gently rolling soil is on broad plains. It has the profile described as representative of the series. Included in mapping are small, widely distributed areas adjacent to outcrops of bedrock where the depth of soil is less than 20 inches, no noticeable lime accumulation is in the profile, and slopes are as steep as 25 percent. Also included are areas of Springerville cobbly clay, 0 to 8 percent slopes, that make up 2 percent of the acreage.

Runoff is medium, and the hazard of erosion is slight. This soil is used for range, wildlife habitat, and watershed.

Areas of this soil that are approximately northeast of Vernon, where elevations are less than about 7,000 feet and the average annual precipitation is between about 16 and 18 inches, support a plant cover that is dominantly side-oats grama, junegrass, western wheatgrass, and squirreltail. Other areas of this soil, which are generally at elevations of more than 7,000 feet and receive 18 to 20 inches of precipitation in an average year, support side-oats grama, needle-and-thread, mutton bluegrass, and junegrass under an open stand of juniper and pinon pine having a canopy of about 20 percent. Capability unit VIs–1, dryland; Clay Loam Upland range site, 16 to 20 inches precipitation.

Tours Series

The Tours series consists of well-drained soils that formed in alluvium derived from sandstone, shale, and basalt. These soils are on generally narrow flood plains and broad alluvial fans. Slopes generally are 0 to 3 percent but range from 0 to 5 percent. Elevations range from 5,400 to 7,000 feet. The average annual precipitation is 8 to 12 inches, the average annual temperature is 48° to 54° F., and the frost-free season is 120 to 140 days. The vegetation is mainly alkali sacaton, galleta, and chamiza.

In a representative profile, the surface layer is reddish-brown heavy clay loam about 8 inches thick. The underlying material is reddish-brown, stratified heavy clay loam, silt loam, heavy loam, and heavy silt loam that extends to a depth of 62 inches. The soil is calcareous and moderately alkaline throughout.

Permeability is moderately slow, and the available water capacity is high. The effective root depth is more than 5 feet.

Tours soils are used chiefly for range and wildlife habitat. In places they are irrigated and used for growing alfalfa, sorghum or corn for silage, small grains, and pasture grasses. Most of the irrigated farming is in the vicinity of Saint Johns.

Representative profile of Tours clay loam, 0 to 1 percent slopes, about three-fourths mile northeast of Saint Johns, 1,000 feet north and 300 feet east of the center of sec. 22, T. 13 N., R. 28 E.

Ap—0 to 8 inches, reddish-brown (5YR 5/3) heavy clay loam, dark reddish brown (5YR 3/3) moist; weak, thick, platy structure parting to weak, fine, subangular and angular blocky; very hard when dry, firm when moist, sticky and plastic when wet; many very fine roots, common fine roots, and few medium roots; many, very fine, interstitial pores and common, fine and medium, tubular pores; few worm casts; strongly effervescent; moderately alkaline; clear, smooth boundary.

C1—8 to 22 inches, reddish-brown (5YR 5/3) heavy clay loam, dark reddish brown (5YR 3/3) moist; weak, coarse and very coarse, prismatic structure; very hard when dry, firm to friable when moist, sticky and plastic when wet; common very fine and fine roots; many, very fine and fine, interstitial pores and common, fine and medium, tubular pores; many wormholes and worm casts; strongly effervescent; moderately alkaline; clear, smooth boundary.

C2—22 to 35 inches, reddish-brown (5YR 5/3) heavy silt loam, reddish brown (5YR 4/3) moist; massive; hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine roots; many, very fine, tubular pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C3—35 to 56 inches, reddish-brown (5YR 5/3) heavy loam, reddish brown (5YR 4/3) moist; few to common, medium, distinct, dark-red (2.5YR 3/6) iron mottles; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine roots; many, very fine, interstitial pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C4—56 to 62 inches, reddish-brown (5YR 5/3) silt loam, reddish brown (5YR 4/3) moist; few, fine and medium, dark-red (2.5YR 3/6) iron mottles; massive; hard when dry, firm when moist, slightly sticky and plastic when wet; few very fine and fine roots; few, very fine, tubular pores; strongly effervescent; moderately alkaline.

The soil between depths of 10 and 40 inches ranges from heavy loam or heavy silt loam to clay loam, and it is stratified with thin layers of finer textured or coarser textured soil material in some places. The soil ranges from slightly calcareous to strongly calcareous. The lime generally is well disseminated, but accumulations of segregated lime can occur as lime veins and filaments. Local areas are affected by salts and alkali. The A horizon ranges from 7.5YR to 2.5YR in hue, is 3 or 4 in chroma, and ranges from 4 to 6 when dry and 3 or 4 when moist. The surface layer is mainly silty clay loam and clay loam, but in places it is loam, silt loam, sandy clay loam, or sandy loam. The C horizon is 2.5YR or 5YR in hue, ranges from 3 to 6 in chroma, and is 4 or 5 in value when dry.

Tours sandy loam (TH).—This soil is on flood plains and fans that are as much as three-fourths mile wide. It has a profile similar to the one described as representative of the series, but the surface layer is sandy loam 6 to 9 inches thick. Slopes are mainly 0 to 3 percent. Elevations range from 5,400 to 6,500 feet, and the frost-free season is 120 to 140 days. Included in mapping are areas of Tours clay loam that make up about 5 percent of the acreage and areas of Fruitland sandy loam, 1 to 8 percent slopes, that make up about 1 percent. A seasonal perched water table is at a depth of about 2 feet in small areas of included soils just south of Sanders.

Runoff is slow, and the hazard of erosion is slight. This soil is used for range and wildlife habitat. Capability unit VIc–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Tours loam (TL).—This soil is on narrow alluvial fans and flood plains. It has a profile similar to the one described as representative of the series, but the surface layer is loam about 5 to 8 inches thick. Slopes generally are 1 to 3 percent but range from 1 to 5 percent. Elevations range from 6,000 to 7,000 feet. Included in mapping are areas of Tours clay loam that make up about 3 percent of the acreage. Also included, in a few places, are areas that have injurious amounts of soluble salts and alkali, as shown on the detailed soil map by a symbol for saline and alkali spot, and areas that are subject to periodic overflow of short duration.

Runoff is slow, and the hazard of erosion is slight. This soil is used for range, wildlife habitat, and watershed. Capability unit VIc–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Tours sandy clay loam, 3 to 5 percent slopes (TmC).—This soil is on flood plains and fans of narrow drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is sandy clay loam about 4 to 9 inches thick. Included in mapping are small areas that have injurious amounts of salt and alkali, as shown on the detailed soil map by a symbol for saline and alkali spot, and small areas that are subject to overflow of short duration.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range and wildlife habitat. Capability unit VIe–1, dryland; Loam Fans range site, 10 to 14 inches precipitation.

Tours clay loam (TO).—This soil is on broad flood plains and alluvial fans. Slopes generally are 0 to 3 percent but range from 0 to 5 percent. Included in mapping are areas of Navajo clay that make up 4 percent of the acreage, areas of Jocity sandy clay loam that make up 2 percent, and small areas, adjacent to stream channels, that are frequently overflowed.

Runoff is slow, and the hazard of erosion is slight. This soil is used for range and wildlife habitat. Capability unit

VIc–1, dryland; Clay Bottoms range site, 10 to 14 inches precipitation.

Tours clay loam, 0 to 1 percent slopes (TrA).—This soil is on broad flood plains and alluvial fans. It has the profile described as representative of the series. Included in mapping, adjacent to the Little Colorado River, are small areas that are subject to frequent overflow.

Runoff is slow, and the hazard of erosion is slight. This soil is used for range, wildlife habitat, and irrigated farming. Crops grown are alfalfa, sorghum or corn for silage, small grains, and pasture. Capability units IIc–1, irrigated, and VIc–1, dryland; Clay Bottoms range site, 10 to 14 inches precipitation.

Tours clay loam, 1 to 3 percent slopes (TrB).—This soil is on flood plains and broad alluvial fans. In places the soil is hummocky. Included in mapping are small areas that are subject to overflow of short duration.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, wildlife habitat, and irrigated farming. Crops grown are alfalfa, sorghum or corn for silage, small grains, and pasture. Capability units IIe–1, irrigated, and VIc–1, dryland; Clay Bottoms range site, 10 to 14 inches precipitation.

Tours clay loam, saline-alkali (Tu).—This nearly level soil is in irregularly shaped areas of flood plains that are from several hundred feet to 1½ miles wide. The main areas of this soil are near Lyman Dam and just north of Saint Johns. This soil has a profile similar to the one described as representative of the series, but it contains soluble salt and alkali. Slopes generally are 0 to 1 percent. Included in mapping are areas that are not saline-alkali, and these make up about 25 percent of the total acreage. Also included are areas where the water table fluctuates from the surface to a depth of about 4 feet, and these make up about 10 percent. Small areas that are subject to overflow of short duration are also included.

Runoff is slow, and the hazard of erosion is slight. This soil is used for range and wildlife habitat. Capability unit VIIs–2, dryland; Saline Bottoms range site, 8 to 12 inches precipitation.

Travertine Rock Land

Travertine rock land (TV) consists of travertine cones, approximately 50 to 100 feet high, that were formed by water from hot springs. Some of the cones near Lyman Lake still have cavernous interiors; however, most of the openings have collapsed, and this has left only depressional areas in the top of the cones. The land type is 60 percent outcrops of travertine rock and 30 percent a loamy soil less than 4 inches deep. A typical area of this land type is in the NW¼ of sec. 20, T. 12 N., R. 29 E. Slopes range from 5 to 20 percent. Elevations range from 5,500 to 6,500 feet. Runoff is medium. The hazard of erosion is moderate. The average annual precipitation is 10 to 16 inches, the average annual temperature is 49° to 52° F., and the frost-free season is 130 to 140 days.

Included with this land in mapping are areas of Winona fine sandy loam, 0 to 8 percent slopes, that make up about 10 percent of the total acreage.

This land type is used for range and wildlife habitat. The vegetation is a sparse cover of blue grama and three-awn and a few junipers. Capability unit VIIs–1, dryland; Shallow Upland range site, 8 to 12 inches precipitation.

Winona Series

The Winona series consists of well-drained soils that formed in residuum derived from limestone on undulating plains and mesa tops. Slopes are 0 to 8 percent. Elevations range from 5,500 to 6,800 feet. The average annual precipitation is 10 to 12 inches, the average annual temperature is 49° to 52° F., and the frost-free season is 130 to 140 days. The vegetation is a sparse cover of blue grama, three-awn, snakeweed, winterfat, and juniper.

In a representative profile, the surface layer is grayish-brown fine sandy loam about 2 inches thick. The underlying material is grayish-brown gravelly loam, about 4 inches thick, that is underlain by limestone bedrock. The soil is moderately alkaline and calcareous throughout.

Permeability is moderate, and the available water capacity is low. The effective root depth is 6 to 12 inches.

Winona soils are used for range and wildlife habitat.

Representative profile of Winona fine sandy loam, 0 to 8 percent slopes, about 8 miles east-southeast of Saint Johns, 1,000 feet south and 510 feet west of the northeast corner of sec. 14, T. 12 N., R. 29 E.

A1—0 to 2 inches, grayish-brown (10YR 5/2) fine sandy loam, dark brown (10YR 4/3) moist; weak, very fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; common very fine and fine roots; common, very fine, interstitial pores; 5 percent gravel; violently effervescent; moderately alkaline; clear, smooth boundary.

Cca—2 to 6 inches, grayish-brown (10YR 5/2) gravelly loam, dark brown (10YR 4/3) moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine roots; common, fine and very fine, tubular pores; 20 percent gravel; violently effervescent; common to many hard fragments of white (10YR 8/2) calcium carbonate; moderately alkaline; abrupt, irregular boundary.

R—6 to 10 inches, light-gray (10YR 7/2) limestone bedrock.

Depth to bedrock ranges from 6 to 12 inches. Gravel, cobbles, and stones make up 10 to 35 percent of the total soil material. The A and C horizons are 10YR or 7.5YR in hue, range from 2 to 4 in chroma when moist, and are 5 or 6 in value when dry and 3 or 4 when moist.

Winona fine sandy loam, 0 to 8 percent slopes (WFB).—This soil is on plains and mesa tops and on the escarpments that are at the edges of the plains and around the mesas. Slopes generally are 0 to 5 percent. Included in mapping are areas of limestone rock outcrop and very shallow gravelly sandy loam soils that have slopes of 8 to 60 percent and make up as much as 20 percent of the total acreage. Also included are areas of deep loamy soils that formed in alluvium in narrow swales and on flood plains and make up about 1 percent.

Runoff is medium, and the hazard of erosion is moderate. Geologic erosion is active. This soil is used for range and wildlife habitat. Capability unit VIs–1, dryland; Shallow Upland range site, 8 to 12 inches precipitation.

Ziegler Series

The Ziegler series consists of well-drained soils that formed in volcanic cinders and ash on cinder cones and adjacent plains. Slopes on the plains generally are 0 to 8 percent but range from 0 to 12 percent. Slopes on the cinder cones generally are 10 to 40 percent but range from 8 to 60 percent. Elevations range from 6,000 to 7,500 feet.

The average annual precipitation is 16 to 20 inches, the average annual temperature is 47° to 49° F., and the frost-free season is 80 to 90 days. The vegetation is mainly blue grama, western wheatgrass, juniper, and pinon pine. Also, there are scattered ponderosa pines.

In a representative profile, the surface layer is reddish-brown gravelly clay loam about 3 inches thick. The subsoil is reddish-brown gravelly clay and gravelly clay loam about 21 inches thick. The underlying material is light reddish-brown cinders that extend to a depth of more than 5 feet. The soil is neutral in the surface layer and upper part of the subsoil and moderately alkaline in the lower part of the subsoil and in the underlying material.

Permeability is moderately slow, and the available water capacity generally is moderate but is low on the cinder cones. The effective root depth is more than 60 inches.

Ziegler soils are used principally for range, wildlife habitat, and watershed. A few small areas are used for dryland farming of silage and pasture crops. Some areas are subdivided as cabin sites.

Representative profile of Ziegler gravelly clay loam, 0 to 8 percent slopes, 4½ miles west of Vernon, adjacent to the pit silo south of the house, in the SW¼NW¼SW¼ sec. 14, T. 10 N., R. 24 E.

A1—0 to 3 inches, reddish-brown (5YR 4/3) gravelly clay loam, dark reddish brown (5YR 3/3) moist; weak, fine, granular structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; many, fine and very fine, interstitial pores; neutral; abrupt, smooth boundary.

B1t—3 to 8 inches, reddish-brown (5YR 4/3) gravelly clay loam, dark reddish brown (5YR 3/3) moist; moderate, medium and fine, subangular blocky structure parting to moderate, medium and fine, granular; hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; many, fine and very fine, interstitial pores; common thin clay films on ped faces and in pores; neutral; clear, smooth boundary.

B2t—8 to 18 inches, reddish-brown (5YR 4/3) gravelly clay, dark reddish brown (5YR 3/3) moist; strong, fine and medium, angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common very fine roots; many, very fine, interstitial pores; many thin clay films on ped faces and in pores; moderately alkaline; clear, smooth boundary.

B3tca—18 to 24 inches, reddish-brown (5YR 5/4) very gravelly clay loam, red (2.5YR 5/6) crushed, yellowish red (5YR 4/6) moist, reddish brown (5YR 4/4) moist and crushed; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few coarse roots; many, very fine, interstitial pores; few thin clay films on cinders and in pores; slightly effervescent; few, medium, white (7.5YR 8/1) lime segregations in a few pockets; moderately alkaline; clear, irregular boundary.

Cca—24 to 62 inches, light reddish-brown (5YR 6/3) moist cinders; massive; single grained; loose dry and moist; few coarse roots; many, fine to coarse, interstitial pores; very few thin clay films on cinders in upper few inches; violently effervescent; common seams and pockets of white (7.5YR 8/1) lime segregations and weak cementation; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. The A horizon and upper part of the B horizon range from 7.5YR or 5YR in hue, are 2 or 3 in chroma, and range from 3 to 5 in value when dry and are 2 or 3 when moist. The A horizon is gravelly loam or gravelly clay loam. The lower part of the B horizon ranges from 7.5YR to 2.5YR in hue but is mainly 5YR; it ranges from 3 to 6 in chroma and is 4 or 5 in value when dry and 2 to 4 when moist. The B2t horizon is heavy clay loam, clay, gravelly clay loam, or gravelly clay that is more than 35 percent clay.

Ziegler gravelly loam, 1 to 5 percent slopes (ZeC).—This soil is on narrow plains that are generally west of Vernon. It has a profile similar to the one described as representative of the series, but the surface layer is gravelly loam about 6 to 10 inches thick.

Runoff is medium, and the hazard of erosion is moderate. This soil is used mainly for range, wildlife habitat, and watershed. Small areas are used for dryland farming for silage and pasture crops. Capability unit IVe-8, dryland; Clay Loam Upland range site, 16 to 20 inches precipitation.

Ziegler gravelly clay loam, 0 to 8 percent slopes (ZGB).—This soil is on fans and plains adjacent to cinder cones that are generally west of Vermont. It has the profile described as representative of the series. Slopes are mainly 4 to 6 percent. Included in mapping, where slopes are steeper, are small areas of basalt rock outcrop. Also included are areas of Thunderbird cobbly clay loam, 0 to 15 percent slopes, and Springerville clay that make up about 5 percent of the acreage.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for range, wildlife habitat, and watershed. It can be used for dryland cropping. Capability unit IVe-8, dryland; Clay Loam Upland range site, 16 to 20 inches precipitation.

Ziegler gravelly clay loam, 8 to 60 percent slopes (ZGE).—This soil is on volcanic cinder cones that are 100 to 500 feet higher than the surrounding terrain. The base of the cones generally is about 40 acres in size but is as much as 320 acres in a few places. The steepest slopes are on the upper half of the cones, but the immediate tops are somewhat rounded. This soil has a profile similar to the one described as representative of the series, but on the steeper slopes the depth to unweathered cinders is more variable; in many places it is 20 to 30 inches. Included in mapping are areas of Bandera gravelly loam, 8 to 60 percent slopes, that make up about 15 percent of the total acreage, areas of unweathered cinders that make up 10 percent, and areas of basalt outcrops that make up 5 percent.

Runoff is rapid, and the hazard of erosion is high. This soil is used for range, wildlife habitat, and watershed. Cinders for road construction are obtained from the underlying material of this soil. Capability unit VIIe-1, dryland; Clay Loam Upland range site, 16 to 20 inches precipitation.

Use and Management of the Soils

The first part of this section describes general management and conservation practices for the soils that are farmed. Then the capability classification system used by the Soil Conservation Service is explained. The capability units in Apache County, Central Part, are briefly described, and suggestions for use and management are given. These are followed by a table of estimated yields and a discussion of range management and wildlife uses of soils. The use of soils in engineering also is discussed.

The use and management of the irrigated soils in the survey area are determined by the economics of the area. A very high percentage of the operators are employed at full-time off-the-farm jobs and, therefore, spend only part time at farming or ranching operations. This commonly

results in only a moderate level of management for the farming or ranching enterprises.

General Management for Farming

This section discusses the major management practices used in growing crops on the soils of Apache County, Central Part.

Fertilization

Nitrogen and phosphorus are the main plant nutrients required for continued high-quality production of the crops grown in the survey area. Alfalfa generally responds to applications of phosphorus.

All soils in the survey area have a low organic-matter content. Use of crop residue and barnyard manure is beneficial. Care should be taken to avoid a buildup of salts when using large amounts of manure. In general, the supply of potassium, iron, calcium, and magnesium is adequate. Sorghum crops may show chlorosis on soils that have a high content of calcium carbonate (lime), which interferes with the absorption of iron and zinc. Field trials and the results of soil tests by a soils laboratory should be used to indicate the kind and amount of fertilizer needed.

Irrigation

Irrigation water is necessary for crops in most of this survey area. The water is supplied from several sources and varies considerably in both quality and quantity. Surface water comes from reservoirs on the Little Colorado River. Underground water supplements surface water in some areas, but in others it is the sole source of supply. Management of irrigation water is control or regulation of applications of irrigation water in such a way that good crop growth is obtained without wasting water or losing soil through erosion.

To irrigate properly, the farmer must know the amount of water the soil will hold, the depth to which plant roots penetrate, and the water requirements of the crop. Most crops should be irrigated when 40 to 50 percent of available soil moisture has been depleted. A soil probe or auger can be used to determine the moisture content of the root zone. Visible plant symptoms of moisture stress are wilting leaves, leaves that are bluish green, or a slow rate of growth. A check of the soil profile should be made about 48 hours after irrigation to determine if water was added uniformly and to the desired depth.

The furrow, corrugation, and border methods are the three most widely used ways of irrigation in the survey area. The border method, which consists of surface flooding between low dikes on fairly level land, is used for most alfalfa, pasture, and small grain. Corrugations, which are shallow, closely spaced furrows, are used in many places on pasture or small grain crops grown on sloping soils. The furrow method, consisting of deeper, larger furrows between the rows, is used for most row crops.

If water is applied too rapidly on clayey soils, such as the Navajo soils in this survey area, it runs off the field. If water is applied too slowly on sandy soils, it penetrates below the root zone and is lost to plant use. A properly designed irrigation system matches the soil characteristics with the right grade and length of run. Concrete-lined ditches and pipelines are used to help conserve water.

Tillage

The soils in this survey area have weak structure. Excessive tillage or tilling when the soil is wet breaks down soil structure, compacts the soil, and restricts the movement of air and water. A compacted layer, called a tillage pan or plowpan, commonly develops as a result of the weight of tillage equipment as it passes over the soil. Tillage should be at varying depths to help prevent formation of a tillage pan. The effect of such a pan can be corrected or avoided by chiseling or subsoiling and by growing deep-rooted crops, such as alfalfa. The practice of minimum tillage limits the number of cultural operations to those that are properly timed and essential to produce a crop and prevent soil damage. It can improve soil tilth, improve the water-intake rate, and lower operation costs.

Conservation cropping [2]

A conservation cropping system is the growing of crops with the needed cultural and management measures. Cropping systems include rotations that contain grasses and legumes as well as rotations in which benefits are obtained without the use of such crops. Generally, a simple crop sequence is used in this survey area. The sequence is influenced by the needs and desires of the farmer and by his ability to finance the production of a particular crop, as well as by government crop controls and the necessity to control diseases, insects, and weeds and to provide good physical condition to the soil. The conservation cropping system should control erosion.

Use of crop residue

To maintain good crop yields, it is essential to incorporate crop residues into the soil. Stubble from barley and grain sorghum and other crop residues are important sources of organic matter. Crop residues improve water intake, increase soil aeration, improve soil structure, and increase the soil micro-organisms that affect the availability of plant nutrients. Residues should be incorporated into the soil as soon after harvest as practical so that residue breakdown can begin as quickly as possible.

Soil organisms, which decompose the residues, require nitrogen. Reduction in crop yields following incorporation of large amounts of residue can be avoided by applying additional nitrogen to aid the decomposition of crop residues.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive land-forming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used

[2] By ARNOLD NOWOTNY, conservation agronomist, Soil Conservation Service.

for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, forest trees, or engineering.

In the capability system, all kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the paragraphs that follow.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. Because of climatic limitations, no class I soils are in this survey area.

Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat. No class V soils are in this survey area.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, saline, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation. In this survey area no class I or V soils are present.

CAPABILITY UNITS are soil groups within the subclass. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–4 or IIIe–6. Thus, in one symbol the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages, the capability units in Apache County, Central Part, are described, and suggestions for the use and management of the soils are given.

Management by capability units

Most soils in Apache County, Central Part, are used for range, but the soils are cultivated and irrigated where they occur in areas adjacent to sources of water. For this reason they have been placed in two capability units, irrigated and dryland. Management practices applicable to those dryland capability units used as range are discussed in the section "Range Management."

Because of the wide ranges in elevation, precipitation, and length of growing season, these items are mentioned in the discussion of each dryland capability unit. Where the soils are irrigated, precipitation is incidental and therefore has been omitted. The length of growing season is critical over the entire survey area. The optimum capability class in the lower, warmer part of the survey area is II, but it ranges to as high as IV in the higher, cooler parts.

Both irrigated and dryland cropping are practiced in the survey area. Irrigation farming is done in the lower, warmer parts, and dryland cropping is practiced in the higher, cooler parts, where precipitation is great enough to permit cropping without irrigation but where the length of growing season imposes a severe limitation on the kind and amount of crops grown.

In the following pages, the capability units in Apache County, Central Part, are described and suggestions for the use and management of the soils are given. The units are not numbered consecutively, because a statewide system is used for numbering the capability units in Arizona and not all the units in the system are represented in this survey area. To find the names of the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this soil survey.

CAPABILITY UNIT IIe–1, IRRIGATED

Tours clay loam, 1 to 3 percent slopes, is the only soil in this unit. It is well drained and has a surface layer of clay loam that is underlain by stratified clay loam, silt loam, and loam. The frost-free period is 120 to 140 days. Runoff is medium, and the hazard of erosion is moderate. Permeability is moderately slow, and the available water capacity is high. The effective root depth is 60 inches or more.

This soil is used for climatically adapted crops, such as corn and sorghum for silage, alfalfa, and pasture. The major limitations are slope and the accompanying moderate hazard of erosion.

Irrigating on the contour and regulating application of water by the use of siphon tubes help to control erosion and obtain proper water penetration. Good management of

crop residue and use of minimum tillage aid in keeping water intake at a desirable rate.

CAPABILITY UNIT IIe-2, IRRIGATED

Jocity sandy loam, 0 to 3 percent slopes, is the only soil in this capability unit. It is well drained and has a surface layer of sandy loam and a subsoil of sandy clay loam. The frost-free season is 120 to 140 days. Runoff is slow, and the hazard of erosion is moderate. Permeability is moderately slow, and the available water capacity is high. The effective root depth is 60 inches or more.

This soil is used for climatically adapted crops, such as corn or sorghum for silage, alfalfa, and pasture. The major limitations are slope and the accompanying moderate hazard of erosion. The sandy loam surface layer is subject to soil blowing, particularly during the early part of the growing season.

Irrigating on the contour and carefully controlling the application of water help to control erosion. The use of siphon tubes to control the application of water helps to obtain proper water penetration. Light, frequent applications of water when the plants are seedlings overcome the slightly reduced available water capacity of the surface layer. Good management of crop residue and use of minimum tillage aid in keeping water intake at a desirable rate. Windbreak plantings around the edges of the field help to control soil blowing. The field should not be left bare for prolonged periods. Crop stubble should be left standing until the field is ready for reseeding.

CAPABILITY UNIT IIe-7, IRRIGATED

This capability unit consists of well-drained soils that have a surface layer of sandy loam, gravelly sandy loam, or sandy clay loam and a subsoil of sandy clay loam. Slopes are 1 to 3 percent. The frost-free season is 120 to 140 days. Runoff is slow, and the hazard of erosion is moderate. Permeability is moderate, and the available water capacity is moderate. The effective root depth is 60 inches or more.

These soils are used for climatically adapted crops, such as corn or sorghum for silage, alfalfa, and small grain for grain or hay. The main limitations are the slope, the accompanying moderate hazard of erosion, and the reduced available water capacity. Irrigating on the contour and using siphon tubes to control the application of water help to control erosion. Light, frequent irrigations overcome the moderate available water capacity of these soils. Good management of crop residue and use of minimum tillage aid in keeping water intake at a desirable rate.

CAPABILITY UNIT IIc-1, IRRIGATED

Tours clay loam, 0 to 1 percent slopes, is the only soil in this capability unit. It has a surface layer of clay loam that is underlain by stratified clay loam, silt loam, and loam. The frost-free season is 120 to 140 days. Runoff is slow, and the hazard of erosion is slight. Permeability is moderately slow, and the available water capacity is high. The effective root depth is 60 inches or more.

This soil is used for climatically adapted crops, such as corn or sorghum for silage, alfalfa, and grasses for pasture. The major limitation is the relatively short growing season, which restricts the choice of crops and their growth.

Good water management to insure proper water penetration, good management of crop residue, and use of minimum tillage are important practices for this soil.

CAPABILITY UNIT IIIe-1, IRRIGATED

This capability unit consists of well-drained soils that have a surface layer of loam that is underlain by sandy loam, loam, silt loam, or clay loam. Slopes range from 1 to 5 percent. The frost-free season is 90 to 120 days. Runoff is mainly medium, and the hazard of erosion is slight to moderate. Permeability is moderately rapid to moderately slow, and the available water capacity is high. The effective root depth is deep.

The main crops grown are alfalfa, small grains for grain or hay, corn or sorghum for silage, and pasture. Silage crops are grown successfully in areas where the frost-free season is 110 to 120 days, but growing them is risky in areas where the season is less than 110 days. The major limitations are slope, the accompanying slight to moderate hazard of erosion, and the short growing season.

The short growing season reduces the number of crops that can be grown and their growth. The use of early maturing crops and good management of irrigation water are necessary on these soils. The use of siphon tubes to control the application of water and irrigating across the slope help to control erosion. Good management of crop residue and the use of minimum tillage aid in maintaining good soil tilth.

CAPABILITY UNIT IIIe-3, IRRIGATED

This capability unit consists of well-drained soils that are clay throughout. Slopes are 1 to 5 percent. The frost-free season is 120 to 140 days. Permeability is very slow, and the available water capacity is high. Runoff is slow or medium, and the hazard of erosion is slight to moderate. The effective root depth is 60 inches or more.

These soils are used for climatically adapted crops, such as corn and sorghum for silage, alfalfa, small grains, and pasture. The major limitations are slope, the accompanying slight to moderate hazard of erosion, very slow permeability, and the clay surface layer.

Irrigating across the slope with siphon tubes to control the application of water helps control erosion. Good management of crop residue, timeliness of tillage, and the use of minimum tillage aid in maintaining good tilth. Rough tillage helps keep water intake at a desirable rate.

CAPABILITY UNIT IIIe-7, IRRIGATED

This capability unit consists of well-drained soils that have a surface layer of fine sandy loam, gravelly fine sandy loam, or sandy clay loam that is underlain by sandy clay loam. Slopes are 3 to 5 percent. The frost-free season ranges from 130 to 140 days. Runoff is medium, and the hazard of erosion is moderate. Permeability is moderate, and the available water capacity is moderate. The effective root depth is 60 inches or more.

These soils are suited to sorghum and corn for silage, alfalfa, small grains for grain or hay, and pasture. The major limitations are slope, the accompanying moderate hazard of erosion, and the moderate available water capacity.

Irrigating on the contour and carefully controlling the application of water by the use of siphon tubes help to control erosion. Light, frequent applications of water overcome the reduced available water capacity. Good management of crop residue and the use of minimum tillage aid in maintaining good tilth.

CAPABILITY UNIT IIIe-8, IRRIGATED

This capability unit consists of well-drained soils that have a surface layer of loam or sandy clay loam and a subsoil of clay. Slopes are 1 to 5 percent. The frost-free season is 120 to 140 days. Permeability is slow and very slow, and the available water capacity is high. Runoff is medium, and the hazard of erosion is moderate. The effective root depth is 60 inches or more.

These soils are suited to corn and sorghum for silage, alfalfa, small grain, and pasture. The major limitations are slope, the accompanying moderate hazard of erosion, and slow and very slow permeability.

Irrigating on the contour and carefully controlling the application of water are desirable on these soils. Small heads of water are required to get adequate water penetration on these slowly and very slowly permeable soils. Good management of crop residue and the use of minimum tillage aid in maintaining good tilth.

CAPABILITY UNIT IIIw-7, IRRIGATED

Only Sandy alluvial land is in this capability unit. This land type consists of well-drained sands to sandy loams that are finely stratified in no orderly arrangement. They are subject to frequent overflow. Slopes are 1 to 3 percent. The frost-free season is 120 to 140 days. Runoff is slow, and the hazard of erosion is slight. Permeability is moderately rapid, and the available water capacity is moderate. The effective root depth is 60 inches or more.

Where these soils are protected from overflow and are irrigated, they are used for alfalfa, pasture, and some sorghum and corn for silage. The major limitations are susceptibility to flooding and the moderate available water capacity. It is necessary to protect these soils and their crops from overflow and subsequent deposition of new soil materials.

Light, frequent applications of water overcome the moderate available water capacity. The soils should not be left bare for prolonged periods. A vegetative cover helps to control soil blowing. Good management of crop residue aids in controlling erosion and maintaining good tilth.

CAPABILITY UNIT IVe-1, DRYLAND

This capability unit consists of moderately well drained soils that have a surface layer of silt loam that is underlain by loam. Slopes are 0 to 10 percent. The average annual precipitation is 18 to 24 inches, and the frost-free season is 80 to 90 days. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is moderate, and the available water capacity is high. The effective root depth is 60 inches or more.

These soils are used mainly for range, wildlife habitat, and watershed, but a limited acreage is dryfarmed to small grains for hay. Also, a small acreage is irrigated to small grains for hay and pasture. All of these soils are suitable for use as cropland, either dryland or irrigated, but early maturing varieties of crops are required because of the short growing season. The major limitations are the short growing season, slope, and the accompanying slight to moderate hazard of erosion.

Where the soils are dryfarmed, contour tilling, stubble mulching, management of crop residue, and use of minimum tillage are desirable. A fallow system may give good results in the dryer parts of the survey area. In irrigated areas, irrigating across the slope and carefully controlling the application of water help to control erosion. Good management of crop residue and the use of minimum tillage aid in maintaining good tilth and keeping water intake at a desirable rate.

CAPABILITY UNIT IVe-5, DRYLAND

This capability unit consists of well-drained soils that have a surface layer of sandy loam and a subsoil of clay loam. Slopes are 1 to 10 percent. The average annual precipitation is 20 to 24 inches, and the frost-free season is 80 to 90 days. Runoff is slight to medium, and the hazard of erosion is slight to moderate. Permeability is moderately slow, and the available water capacity is moderate. The effective root depth is 20 to 40 inches.

These soils are suited to small grains for hay and pasture. The major limitations are the short growing season; poorly distributed, limited precipitation; slope; the accompanying slight to moderate hazard of erosion; soil depth; and the moderate available water capacity.

Planting on the contour and terracing help to control erosion. Stubble mulching and rough tillage aid in conserving moisture and controlling erosion.

CAPABILITY UNIT IVe-6, IRRIGATED

This capability unit consists of well-drained soils that have a surface layer of loam that is underlain by gravelly loam. Slopes are 1 to 10 percent. The frost-free season ranges from 90 to 100 days. Runoff is medium, and the hazard of erosion is moderate. Permeability is moderate, and the available water capacity is low. The effective root depth is 60 inches or more.

These soils are suited to corn or sorghum for silage, small grains, alfalfa, and pasture. Because of the short growing season, crop yields are relatively low.

The major limitations are the limited growing season, which makes crop growth relatively poor; slope; the associated moderate hazard of erosion; and the low available water capacity.

Irrigating on the contour and carefully controlling the application of water by the use of siphon tubes help to control erosion. Light, frequent applications of water overcome the low available water capacity. Good management of crop residue and the use of minimum tillage aid in maintaining good tilth.

CAPABILITY UNIT IVe-8, DRYLAND

This capability unit consists of well-drained soils that have a surface layer of gravelly loam or gravelly clay loam that is underlain by gravelly clay and gravelly clay loam that rests on basaltic cinders. Slopes are 0 to 8 percent. The average annual precipitation is 16 to 20 inches, and the frost-free season is 80 to 90 days. Runoff is medium, and the hazard of erosion is moderate. Permeability is moderately slow, and the available water capacity is moderate. The effective root depth is 60 inches or more.

These soils are suited to small grain for hay and pasture. They are also used for range. The major limitations are the short growing season and poorly distributed, limited precipitation. Slope, the accompanying moderate hazard of erosion, and moderate available water capacity are also limitations.

The use of early maturing crops is required because the growing season is short. Planting on the contour, terracing,

stubble mulching, and rough tillage help to control erosion. Good management of crop residue and the use of minimum tillage aid in maintaining good tilth.

CAPABILITY UNIT IVw-8, IRRIGATED

This capability unit consists of somewhat poorly drained soils that have a surface layer of clay loam and a subsoil of stratified clay and clay loam. Slopes are 0 to 3 percent. The frost-free season is 80 to 90 days. Runoff is very slow to slow, and the hazard of erosion is slight. Permeability is slow, and the available water capacity is high. The effective root depth is 60 inches or more. The seasonal high water table is at a depth of 0 to 2 feet. These soils are subirrigated by the water table.

These soils are suited to small grains for hay or grain and pasture. Water-tolerant grasses and legumes can also be grown for hay.

The short growing season makes it necessary to plant adapted crops that are early maturing. The crops can also be irrigated to assist establishment. Once the crop is established, the water table should be controlled to prevent drastic fluctuation. Leveling or smoothing helps to obtain even distribution of irrigation water. Good management of crop residue and the use of minimum tillage aid in maintaining good tilth and obtaining proper water penetration in these slowly permeable soils.

CAPABILITY UNIT IVs-6, IRRIGATED

This capability unit consists of well-drained soils that have a surface layer of gravelly loam that is underlain by gravelly loam or clay loam and loam. Slopes range from 0 to 5 percent. The frost-free season is 80 to 120 days. Runoff is slow, and the hazard of erosion is slight. Permeability is moderate or moderately slow, and the available water capacity is low to moderate. The effective root depth is 60 inches or more.

These soils are suited to small grains for hay or grain, alfalfa, and pasture. Some corn is grown for silage in areas where the growing season is more than 100 days. The major limitations are the short growing season and the gravelly surface layer. Slope and the hazard of erosion are limitations unless careful irrigation is practiced.

The use of early maturing crops, careful application of water, and irrigating across the slope on the more sloping soils help to control erosion. Good management of crop residue and the use of minimum tillage aid in maintaining good tilth.

CAPABILITY UNIT VIe-1, DRYLAND

This capability unit consists of well-drained soils that have a surface layer of loamy sand to clay that in places is gravelly and a subsoil of sandy loam to clay. Slopes range from 0 to 30 percent. The average annual precipitation ranges from 8 to 24 inches, and the frost-free season from 80 to 140 days. Runoff is slow to rapid, and the hazard of erosion is moderate to high. Permeability is rapid to very slow, and the available water capacity is low to high. The effective root depth ranges from 10 inches to 60 inches or more.

The amount and distribution of precipitation and the hazard of erosion make these soils unsuitable for crops. They are suited to seeding adapted grasses in areas of depleted range. They are used mainly for livestock grazing.

CAPABILITY UNIT VIw-1, IRRIGATED

Shay clay is the only soil in this capability unit. This soil has a surface layer of clay that is underlain by clay. Slopes are 0 to 1 percent. The average annual precipitation is 11 to 12 inches, and the frost-free season is 120 to 130 days. Runoff is very slow, and the hazard of erosion is slight. Permeability is slow, and the available water capacity is high. The effective root depth is 60 inches or more. The seasonal high water table ranges from the surface to a depth of about 2 feet.

Use of this soil is limited by the high water table, frequency of flooding, and limited outlets. Drainage is not considered feasible. The soil is used for livestock grazing. Adapted grasses can be seeded to obtain improved quality forage.

CAPABILITY UNIT VIw-2, DRYLAND

Only Sandy alluvial land is in this capability unit. This land type consists of well-drained, stratified soils that are sand to loamy sand in texture. It is subject to frequent overflow and consequent sedimentation. Slopes range from 1 to 3 percent. The average annual precipitation ranges from 8 to 12 inches. and the frost-free season is 120 to 140 days. Runoff is slow, and the hazard of erosion is slight. Permeability is moderately rapid, and the available water capacity is moderate. The effective root depth is 60 inches or more.

Use of this land type is limited by flooding and the deposit of sediment carried by floodwater. Without water for irrigation and protection from overflow, the land is suitable for range. It is suited to seeding adapted grasses.

CAPABILITY UNIT VIs-1, DRYLAND

This capability unit consists of well-drained soils that have a surface layer of loamy sand to clay that in places is gravelly, cobbly, or stony and a subsoil of sandy loam to clay. Slopes range from 0 to 15 percent. The average annual precipitation ranges from 8 to 24 inches, and the frost-free season is 80 to 140 days. Runoff is slow or medium, and the hazard of erosion is slight or moderate. Permeability is moderately rapid to very slow. The effective root depth ranges from about 6 inches to 60 inches or more.

These soils are too shallow, too stony, or too droughty for crops. They lack adequate precipitation for dryland cropping, and they lack water for irrigation. They are suited to seeding adapted grasses in areas of depleted range.

CAPABILITY UNIT VIc-1, DRYLAND

This capability unit consists of well-drained soils that have a surface layer of sandy loam to clay loam and a subsoil of loam to clay loam. Slopes are 0 to 3 percent. The average annual precipitation is 8 to 11 inches, and the frost-free season is 90 to 140 days. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is moderately slow, and the available water capacity is high. The effective root depth is 60 inches or more.

These soils are used for livestock grazing. They are well suited to seeding grasses in areas of depleted range. They are not suitable for cropping, because no water is available for irrigation. If water were made available, the soils could be cropped successfully.

CAPABILITY UNIT VIIe-1, DRYLAND

This capability unit consists of well-drained soils and land types. The soils have a surface layer of gravelly loam and gravelly clay loam and a highly variable subsoil of clay loam and clay. The land types are mainly sandy loam and loamy sand or loam and sandy loam that is shallow over shale. Slopes are 0 to 60 percent and more. The average annual precipitation is 8 to 20 inches, and the frost-free season is 80 to 140 days. Runoff is medium to very rapid, and the hazard of erosion is moderate to very high. Permeability ranges from moderately slow to moderately rapid. The effective root depth is more than 10 inches to 60 inches or more.

Slope and the accompanying hazard of erosion make these soils and land types not suitable for cultivation. They are suitable for livestock grazing. They are also used for wildlife habitat, esthetic purposes, and a source of cinders.

CAPABILITY UNIT VIIs-1, DRYLAND

This capability unit consists of very shallow to very deep, well-drained soils and land types that are mostly very rocky, extremely rocky, or very stony. They have a surface layer of loam to loamy sand that is underlain by sandy loam, very cobbly clay loam, very gravelly loam, or gravelly loam. Slopes are 0 to 40 percent or more. The average annual precipitation is 8 to 24 inches, and the frost-free season is 80 to 140 days. Runoff is slow to rapid, and the hazard of erosion is slight or moderate. Permeability is moderately slow to moderately rapid. The effective root depth is mostly 6 inches or more.

These soils and land types are too rocky to be seeded. They must be used and managed for the natural forage they produce. They are used mainly for livestock grazing, wildlife habitat, and esthetic purposes.

CAPABILITY UNIT VIIs-2, DRYLAND

This capability unit consists of well-drained soils that are affected by salts and alkali. These soils have a surface layer of clay loam and clay that is underlain by stratified loam, silt loam, clay loam, or clay. Slopes are 0 to 1 percent. The average annual precipitation is 8 to 12 inches. Runoff is slow, and the hazard of erosion is slight. Permeability is slow and moderately slow, and the available water capacity is high or moderate. The effective root depth is 60 inches or more.

These soils are too affected by salts and alkali to be seeded. They must be used and managed for the natural forage they produce. They are used mainly for livestock grazing and wildlife habitat.

CAPABILITY UNIT VIIIe-1, DRYLAND

This capability unit consists of steep and very steep, essentially geologic material in which very little soil has formed, and of moderately steep to extremely steep, sandy escarpments and ridges and intervening drainageways. The hazard of erosion is severe.

These areas support little if any vegetation. They are used mainly for esthetic purposes (the Painted Desert) and water production. A small population of wildlife uses these areas.

CAPABILITY UNIT VIIIw-1, DRYLAND

Only Riverwash is in this capability unit. This land type is so frequently flooded that it supports little or no vegetation and cannot be used for crops. It is subject to almost annual shifting and redeposition as a result of flooding at least once a year. It is used mainly for wildlife habitat.

Estimated Yields

Table 2 lists representative cultivated soils in the survey area and shows estimated yields of the important crops grown on these soils. The yields shown are those that can be expected under a moderately high level of management. The soils differ widely in productivity and in their response to different methods of management.

The yield figures are mostly estimates based on yields obtained from soils that are being farmed at a moderately high level of management. The estimates were obtained mainly through field observations and consultations with farmers in the survey area. Actual crop yields were used whenever available. Although data to support many of these estimates are limited, it is believed that the figures are reasonable estimates of the yields that can be expected under good management.

Good management on irrigated soils includes the use of improved crop varieties, use of commercial fertilizers, management of irrigation water to fit the needs of the crop, proper tillage methods, adequately leveled fields for good irrigation, limited aftermath grazing of alfalfa during winter, and the return of all possible organic matter to the soil.

On dryfarmed soils, good management includes proper timing of tillage, stubble mulching, chiseling or ripping of compacted soils, terracing or contour stripcropping on gently sloping soils, and seeding improved varieties of crops.

Range Management [3]

This soil survey covers that part of Apache County that lies between the boundary of the Apache National Forest on the south and the Navajo Indian Reservation on the north. It also takes in small blocks of land, largely cultivated, around Alpine, Nutrioso, Vernon, and Greer that are within the Apache National Forest. Soils of the Rudd and Thunderbird associations (see general soil map) cover the southern one-fourth of this area and are especially valuable for summer grazing. The vegetation is mainly short grasses interspersed with dense stands of juniper in areas near the boundary of the National Forest.

Soils in the central part and western one-fourth of the survey area, the Moenkopie-Sandstone rock land and Tours-Jocity associations, provide good year-round production if they are carefully managed, and these soils are particularly valuable for winter and spring grazing. The vegetation consists of a high proportion of spring- and fall-growing grasses and scattered to dense stands of juniper and forbs. The remaining half of the survey area, in general the northeastern part, including the Clovis-Palma-Hubert association, supports grasses that are fair for winter and spring grazing and good for summer grazing. Juniper stands are thick on some of the more sandy soils in this part of the survey area.

[3] By ALBERT P. THATCHER, range conservationist, Soil Conservation Service, Phoenix, Arizona.

TABLE 2.—*Estimated average acre yields of principal crops*

[Absence of an entry in a column indicates the crop is not suited to the soil or is not commonly grown on it]

Soil	Irrigated			Dryland [1]				
	Sorghum for silage	Wheat	Oats	Corn for silage	Alfalfa	Wheat for hay	Oats for hay	Sorghum or corn for silage
	Tons	*Bu*	*Bu*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Cambern sandy loam, 1 to 3 percent slopes						0.8	1.1	
Cambern sandy loam, 3 to 5 percent slopes						.7	1.0	
Cambern sandy loam, 5 to 10 percent slopes						.7	1.0	
Clover Springs silt loam, 1 to 3 percent slopes						.9	1.2	
Clover Springs silt loam, 3 to 5 percent slopes						.8	1.1	
Clovis fine sandy loam, 1 to 3 percent slopes	22			15	5.0			
Clovis sandy clay loam, 1 to 3 percent slopes	23	60	70	23	6.0			
Clovis sandy clay loam, 3 to 5 percent slopes	22	55	65	22	6.0			
Clovis sandy clay loam, thin solum, 1 to 3 percent slopes	20	48	55	18	5.0			
Clovis sandy clay loam, thin solum, 3 to 5 percent slopes	18	46	52	17	5.0			
Eagar gravelly loam, 0 to 5 percent slopes	12	25	36	17	2.0			
Eagar loam, 1 to 3 percent slopes	18	32	38	16	2.5			
Eagar loam, 3 to 5 percent slopes	16	35	40	18	2.5			
Fruitland loam, cold variant, 1 to 5 percent slopes	18	26	36	15	4.0			
Hereford gravelly loam, 0 to 3 percent slopes		30	40	16	3.0			
Hereford loam, 1 to 3 percent slopes	18				3.5			
Hereford loam, 3 to 5 percent slopes	16				3.2			
Jocity sandy loam, 0 to 3 percent slopes	18			12				
Luth clay loam, seeped, 1 to 3 percent slopes						1.0	1.5	
Navajo clay, 0 to 1 percent slopes	18	30	55	12	4.5			
Navajo sandy clay loam, 1 to 3 percent slopes				23	6.0			
Navajo sandy clay loam, 3 to 5 percent slopes				23	6.0			
Nutrioso loam, 0 to 1 percent slopes	20	37	50	20	4.0			
Nutrioso loam, 1 to 3 percent slopes	20	37	50	20	4.0			
Tours clay loam, 0 to 1 percent slopes	23			20	5.5			
Tours clay loam, 1 to 3 percent slopes	22			14	5.5			
Tours sandy clay loam, 3 to 5 percent slopes				12	5.0			
Ziegler gravelly loam, 1 to 5 percent slopes						.8	.5	10

[1] Crops are planted only in years when moisture conditions are favorable at planting time. Hence, years when no crops are planted, about 2 years in 5, are not figured in the average yields.

Range sites and range condition

Range sites are distinctive kinds of rangeland that have different capability for producing native plants. Each range site has a characteristic plant community and, unless materially altered by physical deterioration, retains its ability to reproduce this plant community. Rangeland consists of soils on which the potential plant community is mainly native grasses, forbs, and shrubs that are valuable forage and are produced in sufficient quantity to justify their use for grazing.

The productive capacity of a range site, like that of all farmland, depends on the combined effects of the soils and climate that are characteristic to the site. Because of this combination, a range site has a characteristic potential plant community. The site retains its capacity to produce this plant community so long as the environment is not changed.

Range condition refers to the composition of the present vegetation in a given rate site in relation to the composition of potential natural vegetation. It is expressed in terms of range condition classes. Four classes are defined, each representing a degree of deterioration in the plant cover. A site is in *excellent* condition if 76 to 100 percent of the stand is of the same composition as the potential stand. It is in *good* condition if the percentage is between 51 and 75, in *fair* condition if the percentage is between 26 and 50, and in *poor* condition if the percentage is less than 25.

Under prolonged excessive grazing, the more palatable plants are commonly replaced by less desirable plants. Range plants are classified in three broad categories that are based on response to grazing. The categories are identified as decreasers, increasers, and invaders.

Decreasers are plants that decrease in relative abundance under continuous close grazing. They are mostly perennials that are sought out by livestock because they are the most palatable. They normally are dominant species in the climax plant community.

Increasers are plants that normally increase in abundance as the decreasers decline. Increasers commonly are the shorter, less productive or less palatable members of the climax plant community. Their forage value ranges from high to low.

Invaders are plants that become established only after the more desirable vegetation has been depleted. They are not part of the potential plant community for the particular range site, but they may be normal components of this community on other range sites in the same general area. Invaders most commonly are annual weeds, herbaceous perennials, and woody shrubs or trees.

For effective planning of range management, it is necessary to know not only the present condition of the range

but the trend, that is, whether the condition is improving or deteriorating. Signs of a trend toward deterioration include the appearance of bare spots, the crusting and compaction of the soil, erosion, the formation of hummocks, a decline in vigor, and a reduction in proportion of the better range plants and invasion by plants not native to the site. Signs of a trend toward improvement include the presence in the stand of seedlings and plants of different ages, an improvement in the vigor of the better range plants, and an increase in the proportion of the better plants in the stand and a decrease in the proportion of invaders.

In the following pages the range sites of Apache County, Central Part, are described and the climax plants and principal invaders on the sites are named. Also given is an estimate of the potential annual yield of air-dry vegetation for each site when it is in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this soil survey.

CINDER UPLAND RANGE SITE, 12 TO 16 INCHES PRECIPITATION

This range site consists of well-drained soils that have a surface layer of gravelly or very gravelly loam. The underlying material is unweathered cinders. Slopes are 0 to 60 percent. The average annual precipitation is 12 to 16 inches. Permeability is moderately rapid in the surface layer and very rapid in the underlying material.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Side-oats grama	15 to 25
Black grama	5 to 15
Wolftail	5 to 10
Squirreltail	0 to 5
Blue grama	15 to 35
Three-awn	0 to 5
Chamiza	5 to 15

If this site is in excellent condition, the total annual yield of air-dry herbage is about 850 pounds per acre in favorable years and 450 pounds in less favorable years. Approximately 90 percent of this yield is used as forage by cattle, sheep, deer, and antelope.

If this range site is repeatedly misused, blue grama increases at the expense of the taller growing grasses. The palatable shrubs disappear, and oneseeded juniper invades the site.

In addition to good grazing management, brush control and range seeding are beneficial.

CLAY BOTTOMS RANGE SITE, 10 TO 14 INCHES PRECIPITATION

This range site consists of well-drained soils that have a surface layer of clay, sandy clay loam, and clay loam. The underlying material is clay to heavy loam. Slopes are 0 to 5 percent. The average annual precipitation is 8 to 12 inches, but additional moisture is added to these soils as a result of their position on valley floors and runoff from adjacent higher lying soils. Permeability is moderately slow and very slow.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Alkali sacaton	30 to 60
Squirreltail	10 to 15
Vine-mesquite	10 to 25
Galleta	5 to 10
Spike muhly	10 to 15
Blue grama	5 to 10
Indian ricegrass	5 to 10
Chamiza	10 to 25

If this site is in excellent condition, the total annual yield of air-dry herbage is about 3,500 pounds per acre in favorable years and about 1,200 pounds in less favorable years. The frequency of intermittent overflows of water contributes to this wide range. Approximately 90 percent of the yield is used as forage by cattle, sheep, deer, and antelope.

If this range site is repeatedly misused, such plants as vine-mesquite and chamiza are replaced by alkali sacaton. In areas that are in poor condition, isolated plants of alkali sacaton remain and annuals become part of the plant community. Change in composition of the vegetation through good range management generally is very slow.

In addition to the usual management practices, range seeding and pitting are beneficial.

CLAY FANS RANGE SITE, 8 TO 12 INCHES PRECIPITATION

This range site consists of well-drained soils that have a surface layer of sandy clay loam and clay. This is underlain by sandy clay loam and clay. Slopes are 0 to 8 percent. The average annual precipitation is 8 to 13 inches. Permeability is slow and very slow.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Indian ricegrass	5 to 10
Squirreltail	5 to 10
Needle-and-thread	0 to 5
Blue grama	15 to 25
Black grama	0 to 5
Alkali sacaton	30 to 15
Galleta	10 to 15
Dropseed	5 to 10
Mound saltbush	0 to 5
Shadscale	0 to 5
Chamiza	10 to 15

If this site is in excellent condition, the total annual yield of air-dry herbage is about 600 pounds per acre in favorable years and about 350 pounds in less favorable years. Approximately 80 percent of this yield is used as forage by cattle, sheep, deer, and antelope.

If this site is repeatedly misused, blue grama, galleta, and dropseed increase. Juniper may invade the site in the absence of fire.

In addition to the usual management practices, range seeding, pitting, and range renovation are beneficial.

CLAY UPLAND RANGE SITE, 16 TO 20 INCHES PRECIPITATION

This range site consists of well-drained soils that have a surface layer of clay or cobbly clay. The underlying material is cobbly clay that rests on basalt at a depth of about 28 to 70 inches. Slopes are 0 to 8 percent. The average annual precipitation is 16 to 20 inches. Permeability is very slow.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Western wheatgrass	25 to 50
Squirreltail	10 to 15
Mutton bluegrass	10 to 15
Spike muhly	5 to 10
Blue grama	15 to 25
Galleta	5 to 10
Rabbitbrush	0 to 5
Perennial forbs	5 to 10
Wooly groundsel	0 to 5

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,100 pounds per acre in favorable years and about 800 pounds in less favorable years. Approximately 80 percent of this yield is used as forage by cattle, sheep, deer, and antelope.

If this site is repeatedly misused, blue grama and spike muhly increase and Utah juniper and oneseed juniper and many annuals may invade the site.

In addition to the usual management practices, brush control and range seeding are beneficial.

CLAY LOAM UPLAND RANGE SITE, 16 TO 20 INCHES PRECIPITATION

This range site consists of well-drained soils that have a surface layer of gravelly or cobbly clay loam or loam. Their subsoil is clay or gravelly clay that overlies basalt or cinders at a depth of 20 to 40 inches. Slopes are 0 to 60 percent. The average annual precipitation is 16 to 20 inches.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Western wheatgrass	10 to 25
Squirreltail	5 to 10
Side-oats grama	10 to 25
Vine-mesquite	5 to 10
Prairie junegrass	0 to 5
Mutton bluegrass	5 to 10
Wolftail	5 to 10
Blue grama	15 to 25
Perennial forbs	5 to 10
Spike muhly	0 to 5
Oneseed juniper or Utah juniper [1]	0 to 10
Pinon pine [1]	0 to 5

[1] If fire is frequent, these plants are not a significant part of the climax plant community.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,200 pounds per acre in favorable years and 800 pounds in less favorable years. Approximately 90 percent of this yield is used as forage by cattle, sheep, deer, and antelope.

If this site is repeatedly misused, the taller grasses are replaced by blue grama, galleta, and ring muhly. Such woody plants as juniper and pinon pine commonly are dominant on the site in the absence of fire.

In addition to the usual management practices, brush control, range seeding, and contour furrowing are beneficial.

LOAM BOTTOMS RANGE SITE, 16 TO 24 INCHES PRECIPITATION

This range site consists of well drained and moderately well drained soils that have a surface layer of loam, silt loam, and clay loam. The underlying material is stratified and ranges from sandy loam to clay but is mainly loam to clay loam. Slopes are 0 to 10 percent. The average annual precipitation ranges from 10 to 24 inches, but where the precipitation is lowest, the soils receive additional moisture in the form of overflow or runoff from adjacent soils. Permeability is moderate to slow.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Western wheatgrass	20 to 40
Squirreltail	5 to 10
Vine-mesquite	10 to 15
Side-oats grama	5 to 10
Blue grama	20 to 35
Spike muhly	5 to 10
Chamiza	10 to 15
Alkali sacaton	0 to 10
Winterfat	0 to 10

If this site is in excellent condition, the total annual yield of air-dry herbage is about 4,000 pounds per acre in favorable years and about 1,200 pounds in less favorable years. Nearly 100 percent of this yield is used as forage by cattle, sheep, deer, antelope, and elk.

If this site is repeatedly misused, blue grama increases and annuals invade at the expense of the more readily damaged, taller growing species.

In addition to the usual management practices, range seeding and pitting are beneficial.

LOAM FANS RANGE SITE, 10 TO 14 INCHES PRECIPITATION

This range site consists of well-drained soils that have a surface layer of sandy loam, loam, and sandy clay loam. The underlying material is stratified sandy loam to heavy clay loam. Some of these soils are gravelly and cobbly throughout. Slopes are 0 to 30 percent. The average annual precipitation ranges from 10 to 20 inches, but much of the larger amount of precipitation falls as snow that is lost through deep percolation during snowmelt. Permeability is moderately rapid to moderately slow.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Black grama	5 to 15
Needle-and-thread	5 to 10
Indian ricegrass	5 to 10
Wolftail	5 to 10
Blue grama	20 to 30
Galleta	0 to 5
Alkali sacaton	5 to 15
Chamiza	5 to 10
Winterfat	5 to 10
Squirreltail	5 to 10

If this site is in excellent condition, the total annual yield of air-dry herbage is abount 800 pounds per acre in favorable years and about 500 pounds in less favorable years. Approximately 90 percent of this yield is used as forage by cattle, sheep, deer, and antelope.

If this site is repeatedly misused, the short grasses, such as blue grama and galleta, increase; juniper and annuals invade the site; and the tall grasses and palatable shrubs decrease.

In addition to the usual management practices, range seeding, contour furrowing, and brush control are beneficial.

LOAMY UPLAND RANGE SITE, 8 TO 12 INCHES PRECIPITATION

This range site consists of well-drained soils that have a surface layer of loamy sand, fine sandy loam, sandy loam, or sandy clay loam that is gravelly in some places. Their subsoil is sandy clay loam or gravelly sandy clay loam and gravelly clay loam. Slopes are 0 to 30 percent. The average annual precipitation ranges from 8 to 12 inches. Permeability is moderate.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Indian ricegrass	10 to 15
Blue grama	15 to 25
Needle-and-thread	10 to 15
Squirreltail	10 to 15
Black grama	25 to 50
Galleta	25 to 35
Sand dropseed	5 to 10
Chamiza	10 to 15
Oneseed juniper and Utah juniper [1]	0 to 10

[1] If fire is frequent, these plants are not a significant part of the climax plant community.

If this site is in excellent condition, the average annual yield of air-dry herbage is about 600 pounds per acre in favorable years and about 300 pounds in less favorable years. Approximately 90 percent of this yield is used as forage by cattle, sheep, deer, and antelope.

If this site is repeatedly misused, the short grasses increase at the expense of the taller grasses. Juniper commonly increases in the absence of fire. In areas that are in fair or poor condition, annuals become a significant part of the plant community.

In addition to the usual management practices, brush control, range seeding, and contour furrowing are beneficial.

LOAMY UPLAND RANGE SITE, 12 TO 16 INCHES PRECIPITATION

This range site consists of well-drained soils that have a surface layer of loamy sand, sandy loam, or loam that is gravelly or stony in places. Their subsoil is loam to clay loam or gravelly heavy loam to gravelly clay loam. Some of these soils are underlain by bedrock at a depth of 20 to 40 inches. Slopes are 0 to 40 percent. The average annual precipitation ranges from 12 to 16 inches, but much of the larger amounts of precipitation falls as snow that is lost through deep percolation during snowmelt. Permeability is moderate or moderately slow.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Wolftail	5 to 10
Squirreltail	5 to 10
Black grama	15 to 25
Needle-and-thread	10 to 15
Spike muhly	5 to 10
Side-oats grama	10 to 15
Muttongrass	5 to 10
Western wheatgrass	5 to 10
Blue grama	25 to 40
Galleta	5 to 10
Dropseed	5 to 10
Chamiza	5 to 10
Winterfat	5 to 10
Juniper [1]	0 to 10
Pinon pine [1]	0 to 10
Ponderosa pine [1]	0 to 10

[1] If fire is frequent, these plants are not a significant part of the climax plant community.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 800 pounds per acre in favorable years and about 500 pounds per acre in unfavorable years. Approximately 80 percent of this yield is used as forage for cattle, sheep, deer, and antelope.

If this site is repeatedly misused, juniper increases and the short grasses, such as blue grama and galleta, increase. In areas that are in poor condition, many annual grasses and forbs become part of the plant community.

In addition to the usual management practices, brush control, range seeding, and contour furrowing may be needed to restore productivity of the site.

MEADOW RANGE SITE, 12 TO 25 INCHES PRECIPITATION

This range site consists of poorly drained soils that have a surface layer of clay loam or clay. The underlying material is clay loam or clay. The water table fluctuates seasonally; in places it is at the surface during the growing season, but in other places it is as much as 24 inches below the surface. Slopes are 0 to 3 percent. The average annual precipitation ranges from 12 to 25 inches. Permeability is slow.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Tufted hairgrass	25 to 50
Mannagrass	10 to 15
Alpine timothy	5 to 10
Sedges and rushes	10 to 15
Native bluegrass	10 to 15
Bluejoint reedgrass	5 to 25
Willows	5 to 10
Shrubby cinquefoil	5 to 10
Ticklegrass	0 to 5
Velvetgrass	5 to 10
Short-awn foxtail	0 to 5
Perennial forbs	5 to 10

If this site is in excellent condition, the total annual yield of air-dry herbage is about 5,500 pounds per acre in favorable years and about 4,000 pounds in less favorable years. Approximately 90 percent of this yield is used as forage by cattle, sheep, deer, elk, and antelope.

If this site is repeatedly misused, the taller grasses, sedges, and rushes are replaced by shorter species. Many species of introduced grasses invade the plant community. In areas that are in poor condition, willows and water-loving shrubs may also become abundant.

In addition to the usual management practices, brush control and range seeding are beneficial.

SALINE BOTTOMS RANGE SITE, 8 TO 12 INCHES PRECIPITATION

This range site consists of salt- and alkali-affected, well-drained soils. These soils have a surface layer of clay or clay loam and underlying material of clay or stratified heavy loam to heavy clay loam. Slopes are 0 to 1 percent. The average annual precipitation is 8 to 12 inches. Permeability is very slow or moderately slow.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Alkali sacaton	40 to 50
Alkali muhly	5 to 10
Inland saltgrass	10 to 15
Western wheatgrass	10 to 15
Vine-mesquite	0 to 10

	Percentage by weight
Squirreltail	5 to 10
Chamiza	10 to 15
Mound saltbrush	0 to 5
Shadscale	0 to 5

If this site is in excellent condition, the total annual yield of air-dry herbage is 1,500 pounds per acre in favorable years and about 800 pounds in less favorable years. Approximately 80 percent of this yield is used as forage by cattle, sheep, deer, and antelope.

If this site is repeatedly misused, the woody species increase, the short grasses increase, and many annual grasses and forbs become a part of the plant community.

In addition to the usual management practices, range seeding, brush control, and range pitting are beneficial.

SAND UPLAND RANGE SITE, 10 TO 14 INCHES PRECIPITATION

This range site consists of well-drained and somewhat excessively drained soils that have a surface layer of loamy sand. These soils have a subsoil of sandy loam and fine sandy loam, or they are underlain by loamy sand. Slopes are 0 to 8 percent. The average annual precipitation is 10 to 14 inches. Permeability is moderately rapid or rapid.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Indian ricegrass	20 to 40
Needle-and-thread	10 to 15
Black grama	5 to 10
Dropseed	15 to 25
Sandreed	5 to 20
Sand bluestem	0 to 10
Blue grama	20 to 30
Spiny muhly	5 to 10
Galleta	10 to 15
Mormon tea	5 to 10
Sand sagebrush	5 to 10
Chamiza	5 to 10
Oneseed juniper and Utah juniper[1]	0 to 10

[1] If fire is frequent, these plants are not a significant part of the climax plant community.

If this site is in excellent condition, the total annual yield of air-dry herbage is 800 pounds per acre in favorable years and about 400 pounds in less favorable years. Approximately 80 percent of this yield is used as forage by cattle, sheep, deer, and antelope.

If this site is repeatedly misused, the cool-season mid grasses are replaced by short species that resist or escape grazing pressure. In areas that are in poor range condition, annuals, less palatable shrubs, and close-growing grasses are dominant. Soil blowing may become severe in misused areas.

In addition to the usual management practices, brush control and range seeding are beneficial.

SHALLOW UPLAND RANGE SITE, 8 TO 12 INCHES PRECIPITATION

This range site consists of well-drained, shallow soils that are less than 20 inches deep over bedrock. These soils have a surface layer of fine sandy loam or loamy sand, and their underlying material is sandy loam and gravelly loam. Common to many outcrops of bedrock occur on the landscape. Slopes are 0 to 30 percent. The average annual precipitation is 8 to 12 inches. Permeability is moderately rapid and moderate.

The composition of the potential (climax) community for this site is:

	Percentage by weight
Indian ricegrass	10 to 15
Blue grama	10 to 15
Squirreltail	5 to 10
Galleta	15 to 25
Needle-and-thread	5 to 10
Sand dropseed	5 to 10
Alkali sacaton	15 to 25
New Mexico feathergrass	0 to 5
Twinberry	5 to 10
Winterfat	5 to 10
Chamiza	10 to 20
Mormon tea	5 to 10
Oneseed juniper and Utah juniper[1]	0 to 10

[1] If fire is frequent, these plants are not a significant part of the climax plant community.

If this site is in excellent condition, the total annual yield of air-dry herbage is 400 pounds per acre in favorable years and about 250 pounds in less favorable years. Approximately 80 percent of this yield is used as forage by cattle, deer, sheep, and antelope.

If this site is repeatedly misused, juniper and shrubs increase. In areas that are in poor condition, many annual grasses and forbs become part of the plant community.

In addition to the usual management practices, range seeding is beneficial in selected areas.

SHALLOW UPLAND RANGE SITE, 12 TO 16 INCHES PRECIPITATION

This range site consists of well-drained, shallow soils that are less than 20 inches deep over bedrock. These soils have a surface layer of sandy loam or loam that in places is gravelly, cobbly, stony, or very stony. The underlying material is gravelly loam, or the subsoil is very cobbly clay loam. The average annual precipitation ranges from 11 to 24 inches, but the larger amounts of precipitation fall as snow that is lost through deep percolation during snowmelt. Slopes are 0 to 45 percent. Permeability is moderate or moderately slow.

The composition of the potential (climax) plant community for this site is:

	Percentage by weight
Needle-and-thread	10 to 25
Indian ricegrass	5 to 15
Squirreltail	10 to 25
Wolftail	5 to 10
Side-oats grama	5 to 15
Galleta	5 to 10
Smallseed ricegrass	5 to 10
Mutton bluegrass	5 to 10
Black grama	10 to 15
Prairie junegrass	5 to 10
Blue grama	15 to 25
Sand dropseed	5 to 10
Winterfat	5 to 10
Chamiza	5 to 10
Utah juniper and oneseed juniper[1]	0 to 10
Pinon pine[1]	0 to 5
Ponderosa pine[1]	0 to 10

[1] If fire is frequent, these plants are not a significant part of the climax plant community.

If this site is in excellent condition, the total annual yield of air-dry herbage is 700 pounds per acre in favorable years and about 400 pounds per acre in less favorable years. Approximately 80 percent of this yield is used as forage by cattle, sheep, deer, elk, and antelope.

Pinon pine and juniper generally invade or increase if the site is excessively grazed and fires are suppressed. In areas that are in poor condition, many annual grasses and forbs become part of the plant community.

Wildlife

Big game, small mammals, waterfowl, mourning dove, turkey, and nongame birds are found in Apache County, Central Part. Pronghorn antelope and mule deer are the main species of big game in the survey area. Each species of wildlife is most numerous where the elements of its habitat, including food, water, and protective cover, are satisfied. Favorable habitat elements depend on the suitability of soils and resulting plant communities.

Wildlife is a product of the land, and its abundance is directly related to the extent and diversity of habitat. The relationship of wildlife to soils is correctly expressed as a soil-plant-wildlife relationship, inasmuch as wildlife species are more readily associated with plant communities that make up their habitat than to the soils that produce these communities.

Such soils as those of the Hereford, Clover Springs, Nutrioso, Clovis, and Tours series, which are suited to crops or improved pasture, are also suited to development of favorable habitat for most wildlife.

Soils of dry upland slopes, such as those of the Rudd, Hubert, and Clovis series; those on cinder cones, such as Ziegler and Bandera soils; those in gravelly washes, such as those of the Millett series; and those in rocky areas, such as Moenkopie and Winona soils and Rock land, are generally unfavorable for development of wildlife habitat. However, they are important in supporting habitat for various wildlife species, such as pronghorn antelope and mule deer.

Engineering Uses of the Soils

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this information are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the properties of soils that are highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 3, 4, and 5, which show, respectively, several estimated soil properties significant in engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those in tables 3 and 4, and it also can be used to make other useful maps.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths of more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists that is not known to all engineers. The Glossary defines many of these terms as they are commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system used by the Soil Conservation Service, Department of Defense (*4*), and other agencies, and the AASHO system (*1*) adopted by the American Association of State Highway Officials.

The Unified system is used to classify soils according to those properties that affect use as construction material for purposes other than highway construction and maintenance and as foundation material. In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content and are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL–ML.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups that range from A–1 to A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing

strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b; A–2–4, A–2–5, A–2–6, A–2–7; and A–7–5 and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 5; the estimated classification, without group index numbers, is shown in table 3 for all soils mapped in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are shown in table 3. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other survey areas. Following are explanations of some of the columns in table 3.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer.

Except for the Luth soils and Riverwash, a water table was not noted within the depth of observation, generally a depth of 5 feet, unless bedrock was encountered at a shallower depth. The seasonal high water table is at a depth of 0 to 2 feet in the Luth soils and 0 to 1 foot in Riverwash.

Soil texture is described in table 3 in the standard terms used by the Department of Agriculture. These terms take into account the relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand."

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 3, but in table 5 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of soil characteristics observed in the field, particularly structure and texture. The estimates in table 3 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and other terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of water-soluble salts in the soil more soluble than gypsum. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Salinity affects the suitability of a soil for crops, its stability when used as construction material, and its corrosivity to metal and concrete.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material that has this rating.

Corrosivity, as used in table 3, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Frost-action potential refers to the relative degree of movement of the soil that normally occurs in the undisturbed surface layer at freezing temperature. Soils that are most susceptible to damage from frost action are those that are silty and are wet most of the time in winter.

Engineering interpretations of soils

The estimated interpretations in table 4 are based on the engineering properties of soils shown in table 3, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Apache County, Central Part. In table 4, ratings are used to summarize limitations or suitability of the soils for all listed purposes other than for pond reservoir areas; embankments, dikes, and levees; and irrigation. For these particular uses, table 4 lists those soil features not to be overlooked in planning, installation, and maintenance.

TABLE 3.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear in the first column of this table.

Soil series and map symbols	Depth to bedrock	Depth from surface of typical profile	Classification			Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—	
			USDA texture	Unified	AASHO		No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Ft	*In*						
Badland: BA. No valid estimates can be made.								
Bandera: BDB, BDE, BEB.	>5	0–19	Very gravelly loam	GP–GM, GM	A–1 or A–2	0–10	35–65	15–55
		19–60	Cinders	GP	A–1	0–20	15–20	0–5
Bushvalley: BsE, BuC	½–1½	0–10	Very cobbly clay loam.	CL	A–6	30–60	90–100	85–95
		10	Tuff.					
Cambern: CaB, CaC, CaD	1½–3½	0–10	Loam	SM	A–4	0–5	90–100	60–75
		10–28	Clay loam	CL	A–6	0–5	100	60–75
		28	Tuff.					
Claysprings: CcC, CDB	1–1½	0–18	Clay	CH	A–7		95–100	90–100
		18–60	Shale.					
Clover Springs: CE, CgB, CgC, CgD.	>5	0–60	Loam	CL	A–4 or A–6	0–5	90–100	90–100
*Clovis: CLB, CmB, CmC, CnB, CnC, CnE, CoB, CoC, CsB, CsC, CTB. For Palma part of CTB, see Palma series.	>5	0–30	Sandy clay loam	SC	A–2 or A–6	0–5	70–100	60–90
		30–60	Loamy sand or sandy loam.	SM, SC	A–2 or A–4		70–100	60–100
Eagar: EaB, EaC, EaD, EaE, EgC.	>5	0–30	Gravelly loam	GC, SC, or CL	A–6	5–15	65–85	60–80
		30–60	Very gravelly sandy loam.	GP–GM, GM	A–1 or A–2	25–45	35–45	30–40
Eroded land: ER2	>5	0–60	Sandy loam or loamy sand.	SM	A–2		90–100	80–100
Fruitland: FRB	>5	0–60	Sandy loam	SM	A–2		90–100	85–95
Fruitland, cold variant: FuC.	>5	0–60	Fine sandy loam	ML or SM	A–4 or A–2		95–100	85–95
Gullied land: GU. No valid estimates can be made.								
Hereford:								
HDB, HeB, HeC	>5	0–60	Clay loam	CL	A–6		100	95–100
HfB	>5	0–24	Gravelly clay loam	CL or GC	A–6	5–15	65–75	60–70
		24–60	Very gravelly clay loam.	GC	A–2	15–25	35–45	30–40
Hereford, heavy variant: HhB, HrC.	>5	0–12	Loam	CL	A–6	0–15	85–95	80–95
		12–36	Clay	CH	A–7	0–15	95–100	90–100
		36–60	Cobbly clay loam	CL	A–6	20–35	65–75	60–70
Hubert: HUB, HUC2	>5	0–60	Gravelly loam and very gravelly clay loam.	GC	A–2	0–5	30–55	25–50

See footnotes at end of table.

significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions
The symbol > means more than; the symbol < means less than]

Percentage less than 3 inches passing sieve—Con.		Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity		Frost-action potential
No. 40 (0.42 mm)	No. 200 (0.074 mm)								Uncoated steel	Concrete	
				In per hr	*In per in of soil*	*pH value*	*Mmhos per cm at 25° C*				
15–50	10–30	30–40	[1] NP–5	2. 0–6. 0	0. 14–0. 16	6. 0–8. 4	0–2	Low	High	Low	Low.
0	0	[1] NP	NP	6. 0–20. 0	0. 05–0. 07	7. 9–8. 4	0–4	Low	Low	Low	Low.
80–90	60–75	25–35	15–20	0. 2–0. 6	0. 08–0. 11	5. 6–8. 4	0–2	Low	High	Low	Low.
50–60	40–50	25–35	NP–4	0. 6–2. 0	0. 16–0. 18	5. 6–7. 3	0–2	Low	High	Low	Moderate.
55–90	50–80	30–40	15–20	0. 2–0. 6	0. 19–0. 21	5. 6–7. 3	0–2	Moderate	High	Low	High.
90–100	80–90	50–60	30–45	<0. 06	0. 14–0. 16	7. 9–8. 4	4–16	High	High	High	Moderate.
90–100	85–95	25–35	8–15	0. 6–2. 0	0. 18–0. 20	6. 6–8. 4	0–2	Moderate	High	Low	High.
55–75	30–45	25–35	10–20	0. 6–2. 0	0. 14–0. 16	7. 9–8. 4	0–2	Moderate	High	Low	Low.
40–75	15–40	30–40	NP–30	2. 0–6. 0	0. 06–0. 08	7. 9–8. 4	0–4	Low	High	Low	Low.
50–70	35–60	30–40	10–20	0. 6–2. 0	0. 10–0. 12	7. 4–8. 4	0–2	Moderate	High	Low	Moderate.
20–25	10–15	10–20	NP	2. 0–6. 0	0. 03–0. 05	7. 4–8. 4	0–4	Low	High	Low	Low.
60–70	25–35	20–30	2–4	0. 6–6. 0	0. 08–0. 15	7. 4–8. 4	0–2	Low	High	Low	Low.
65–75	25–35	20–30	2–4	2. 0–6. 0	0. 11–0. 13	7. 9–8. 4	0–2	Low	High	Low	Low.
75–85	25–75	30–40	2–8	2. 0–6. 0	0. 13–0. 15	7. 9–8. 4	0–2	Low	High	Low	Moderate.
85–95	65–75	30–40	15–20	0. 2–0. 6	0. 19–0. 21	7. 4–8. 4	2–4	Moderate	High	Low	Moderate.
55–65	45–55	30–40	15–20	0. 2–0. 6	0. 16–0. 19	7. 4–8. 4	0–2	Moderate	High	Low	Moderate.
25–35	20–30	35–40	20–25	0. 2–0. 6	0. 08–0. 10	7. 4–7. 8	0–2	Moderate	High	Low	Low.
75–90	60–70	20–30	10–15	0. 6–2. 0	0–15. 0. 17	6. 1–7. 3	0–2	Moderate	High	Low	Moderate.
90–100	80–90	50–60	35–40	<0. 06	0. 14–0. 16	6. 6–7. 8	0–2	High	High	Low	Moderate.
55–65	50–60	35–40	20–25	0. 20–0. 6	0. 12–0. 14	7. 4–7. 8	2–4	Moderate	High	Low	Moderate.
25–40	20–30	20–30	10–20	0. 6–2. 0	0. 10–0. 12	7. 9–8. 4	0–4	Low	High	Low	Moderate.

TABLE 3.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface of typical profile	Classification			Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—	
			USDA texture	Unified	AASHO		No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Ft	*In*						
*Jocity: JoB, JR, JS—For Claysprings part of JS, see Claysprings series.	>5	0–60	Sandy clay loam	CL or SC	A–6		100	100
Loamy alluvial land: LO	>5	0–60	Stratified material	(2)	(2)	(2)	(2)	(2)
Luth: LuA, LuB	>5	0–37	Clay loam and clay	CL	A–7		100	85–95
		37–60	Gravelly sandy loam	GM	A–2		50–60	45–55
Millett: MGD	>5	0–18	Gravelly sandy clay loam.	GC or SC	A–2 or A–6		55–85	50–80
		18–60	Very gravelly sandy clay loam.	GC	A–2	0–10	40–55	30–50
Moenkopie: MKB, MOD	½–1½	0–9	Sandy loam	SM	A–2	0–10	75–100	65–90
		9	Sandstone.					
Navajo: NaB, NaC, NC, NdA, NdB, NdC, NlA.	>5	0–72	Clay	CH	A–7		100	100
Nutrioso: NT, NuA, NuB, NuC.	>5	0–60	Stratified silt loam	ML or CL	A–4 or A–6		98–100	95–100
		60	Loam and clay loam.					
*Palma: PAB, PSB—For Sheppard part of PSB, see Sheppard series.	>5	0–41	Fine sandy loam	SM	A–2		100	100
		41–60	Sandy clay loam	SC or CL	A–6		100	100
Riverwash: RH—No valid estimates can be made of most properties.	>5							
Rough broken land: RO. No valid estimates can be made.								
Rudd: RvB, RwF, RXB	½–1½	0–13	Gravelly loam	GM	A–2 or A–1	0–30	50–60	40–50
		13	Basalt.					
Sandstone rock land: SA—No valid estimates can be made of most properties.	0–1½							
Sandy alluvial land: SD	>5	0–72	Finely stratified sandy loam to sand.	SM	A–2 or A–4		90–100	85–95
Shay: Sh	>5	0–60	Clay and clay loam	CH	A–7	0–5	95–100	95–100
Sheppard: SMB	>5	0–70	Loamy sand	SM	A–2		100	100
Springerville: Sp, SRB	3–5	0–36	Cobbly clay and clay.	CH	A–7	0–20	75–90	65–85
		36	Basalt.					
Stony rock land: SU—No valid estimates can be made of most properties.	0–1½							

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—Con.		Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity		Frost-action potential
No. 40 (0.42 mm)	No. 200 (0.074 mm)								Uncoated steel	Concrete	
				In per hr	*In per in of soil*	*pH value*	*Mmhos per cm at 25° C*				
80–90	35–55	25–35	10–15	0. 2–0. 6	0. 14–0. 16	7. 9–8. 4	2–8	Moderate	High	Moderate	Moderate.
(2)	(2)	(2)	(2)	0. 2–0. 6	0. 13–0. 19	7. 9–8. 4	(2)	(2)	(2)	(2)	(2).
80–90	70–80	40–50	20–30	0. 06–0. 20	0. 18–0. 20	6. 1–7. 4	0–2	High	High	Low	High.
35–45	20–30	15–25	NP	2. 0–6. 0	0. 07–0. 09	7. 4–8. 4	2–4	Low	High	Low	Moderate.
40–65	20–40	30–40	10–20	0. 6–2. 0	0. 11–0. 13	7. 9–8. 4	0–2	Moderate	High	Low	Moderate.
25–35	15–25	30–40	10–20	0. 6–2. 0	0. 06–0. 08	7. 9–8. 4	2–4	Low	High	Low	Low.
50–70	25–35	15–25	NP–4	2. 0–6. 0	0. 08–0. 14	7. 9–8. 4	2–4	Low	High	Moderate	Moderate.
100	90–100	50–65	25–35	>0. 06	0. 14–0. 16 N1A: 0. 08–0. 11	7. 9–8. 4	0–4 N1A: >8	High	High	Moderate	Moderate. N1A: Moderate.
85–95	80–100	30–40	2–20	0. 2–0. 6	0. 16–0. 21	7. 4–8. 4	0–2	Moderate	High	Low	High.
60–70	25–35	15–25	NP–4	2. 0–6. 0	0. 11–0. 13	6. 6–8. 4	0–2	Low	High	Low	Moderate.
65–80	40–55	30–40	10–20	0. 6–2. 0	0. 13–0. 15	7. 9–8. 4	2–4	Moderate	High	Low	Moderate.
30–40	20–30	35–45	5–15	0. 6–2. 0	0. 13–0. 16	7. 9–8. 4	0–2	Low	High	Low	High.
70–85	30–40	15–25	NP	2. 0–6. 0	0. 08–0. 11	7. 4–9. 0	2–15	Low	High	Moderate	Moderate.
90–100	70–80	50–60	30–40	0. 06–0. 20	0. 14–0. 16	7. 9–8. 4	2–15	High	High	Moderate	Moderate.
65–80	20–35	10–20	NP	6. 0–20. 0	0. 06–0. 08	6. 6–8. 4	0–2	Low	High	Low	Low.
65–85	60–75	70–80	40–50	<0. 06	0. 12–0. 16	7. 9–8. 4	0–2	High	High	Low	Moderate.

TABLE 3.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface of typical profile	Classification			Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—	
			USDA texture	Unified	AASHO		No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Ft	*In*						
Thunderbird: TbC, TDB	1½–2½	0–23 23	Cobbly clay loam and clay. Basalt.	CH	A–7	0–20	70–90	70–90
Tours: TH, TL, TmC, TO, TrA, TrB, Tu.	>5	0–62 62	Stratified clay loam Heavy loam and heavy silt loam.	CL	A–4 or A–6	----------	100	95–100
Travertine rock land: TV. No valid estimates can be made of most properties.	0– ½							
Winona: WFB	½–1	0–6 6	Gravelly loam Limestone.	GM or ML	A–4	0–10	55–95	50–85
Ziegler: ZeC, ZGB, ZGE	>5	0–24	Gravelly clay loam and clay.	CL	A–6	0–25	75–90	70–85
		24–60	Cinders	GP	A–1	0–10	10–15	10–15

[1] NP means nonplastic.

TABLE 4.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

Soil series and map symbols	Degree and kind of limitation for—			Suitability as source of—
	Septic tank absorption fields	Dwellings without basements	Local roads and streets	Road fill
Badland: BA	Severe: too sloping	Severe: too sloping	Severe: too sloping	Too sloping
Bandera:				
BDB	Slight [1]	Slight	Slight	Good
BDE	Severe: too sloping	Severe: too sloping	Severe: too sloping	Fair to poor: too sloping.
BEB	Severe: too rocky	Severe: too rocky	Severe: too rocky	Poor: too rocky
Bushvalley: BsE, BuC	Severe: shallow over bedrock.	Severe: shallow over bedrock.	Severe: shallow over bedrock.	Poor: shallow over bedrock.
Cambern: CaB, CaC, CaD.	Severe: moderately deep over bedrock.	Moderate: moderate shrink-swell potential; moderately deep over bedrock.	Severe: low shear strength.	Poor: low shear strength.
Claysprings: CcC, CDB.	Severe: very slow permeability; shallow over shale.	Severe: high shrink-swell potential; shallow over shale.	Severe: high shrink-swell potential; shallow over shale.	Poor: shallow over shale; high shrink-swell potential.

See footnote at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—Con.		Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity		Frost-action potential
No. 40 (0.42 mm)	No. 200 (0.074 mm)								Uncoated steel	Concrete	
				In per hr	*In per in of soil*	*pH value*	*Mmhos per cm at 25° C*				
65–85	60–70	50–60	30–40	<0. 06	0. 10–0. 12	6. 8–8. 4	0–2	High	High	Low	Moderate.
90–100	70–80	40–50	20–30	0. 2–0. 6	0. 18–0. 20	7. 9–8. 4	0–2 Tu: >8	Moderate	High	Moderate	High.
40–75	35–55	30–40	NP–5	0. 6–2. 0	0. 11–0. 13	7. 9–8. 4	0–2	Low	High	Low	Moderate.
65–75	50–60	40–50	20–30	0. 2–0. 6	0. 15–0. 17	6. 6–8. 4	0–2	Moderate	High	Low	High.
0–15	0–5	NP	NP	6. 0–20. 0	0. 04–0. 08	7. 9–8. 4	0–2	Low	Moderate	Low	Low.

[2] No valid estimates can be made.

engineering properties of the soils

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Suitability as source of—Continued		Soil features affecting—		
Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Too variable to be rated.	Too variable to be rated	Too sloping	Too variable to be rated	Too sloping.
Unsuitable for sand; good for gravel: cinders.	Poor: too gravelly	Rapid permeability	High permeability	Rapid permeability; too sloping.
Unsuitable for sand; good for gravel: cinders.	Poor: too gravelly	Too sloping	High permeability	Too sloping.
Unsuitable for sand; good for gravel: cinders.	Poor: too rocky	Rapid permeability; too rocky.	High permeability	Too rocky.
Unsuitable	Poor: too cobbly	Shallow over bedrock	Cobbly; limited amount of material.	Shallow over bedrock.
Unsuitable	Fair: limited amount of material.	Moderately deep over bedrock.	Moderate shrink-swell potential.	Moderately deep over bedrock; frost-free season is 80 to 90 days.
Unsuitable	Poor: clay	Shallow over shale	High shrink-swell potential; limited amount of material.	Very slow permeability; shallow over shale.

TABLE 4.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—			Suitability as source of—
	Septic tank absorption fields	Dwellings without basements	Local roads and streets	Road fill
Clover Springs: CE, CgB, CgC, CgD.	Moderate: moderate permeability.	Severe: high frost-action potential.	Severe: high frost-action potential.	Poor: high frost-action potential.
*Clovis: CLB, CmB, CmC, CnB, CnC, CoB, CoC, CsB, CsC, CTB. For Palma part of of CTB, see Palma series.	Moderate: moderate permeability.	Moderate: moderate shrink-swell potential.	Moderate: content of fines more than 30 percent; moderate shrink-swell potential.	Fair: content of fines more than 30 percent; moderate shrink-swell potential.
CnE	Moderate: moderate permeability; too sloping.	Moderate: too sloping; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential; slope; content of fines more than 30 percent.	Fair: content of fines more than 30 percent; moderate shrink-swell potential.
Eagar: EaB, EaC, EaD	Moderate: moderate permeability.	Moderate: moderate frost-action potential.	Moderate: moderate frost-action potential.	Fair: moderate frost-action potential.
EaE	Severe: too sloping	Severe: too sloping	Severe: too sloping	Fair: moderate frost-action potential.
EgC	Moderate: moderate permeability.	Moderate: moderate frost-action potential.	Moderate: moderate frost-action potential.	Fair: moderate frost-action potential.
Eroded land: ER2	Too variable to be rated	Severe: very high hazard of erosion.	Slight	Good
Fruitland: FRB	Slight	Slight	Slight	Good
Fruitland, cold variant: FuC.	Slight	Moderate: ML or SM material; moderate frost-action potential.	Moderate: ML or SM material; moderate frost-action potential.	Fair: ML or SM material; moderate frost-action potential.
Gullied land: GU	Severe: too sloping	Severe: too sloping	Severe: too sloping	Too sloping
Hereford: HDB, HeB, HeC	Severe: moderately slow permeability.	Moderate: moderate shrink-swell potential; moderate frost-action potential.	Severe: low shear strength.	Poor: low shear strength.
HfB	Severe: moderately slow permeability.	Moderate: moderate shrink-swell potential; moderate frost-action potential.	Severe: low shear strength.	Poor: low shear strength.
Hereford, heavy variant: HhB	Severe: slow permeability.	Severe: high shrink-swell potential; low shear strength.	Severe: low shear strength.	Poor: low shear strength.
HrC	Severe: slow permeability.	Severe: high shrink-swell potential; low shear strength.	Severe: low shear strength.	Poor: low shear strength.

See footnote at end of table.

engineering properties of the soils—Continued

Suitability as source of—Continued		Soil features affecting—		
Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Unsuitable	Good	Moderate permeability	Medium shear strength; medium susceptibility to piping.	Frost-free season is 80 to 90 days.
Poor for sand: fines; unsuitable for gravel.	Fair: sandy clay loam. Poor for CmB and CmC: gravelly.	Moderate permeability	Moderate shrink-swell potential; medium susceptibility to piping.	Moderate permeability; high available water capacity.
Poor for sand: fines; unsuitable for gravel.	Poor: gravelly	Moderate permeability	Moderate shrink-swell potential.	Too sloping.
Unsuitable for sand; poor for gravel: fines.	Poor: too gravelly	Moderate permeability	Too sloping; medium suspectibilty to piping; low compressibility.	Low available water capacity.
Unsuitable for sand; poor for gravel: fines.	Poor: too sloping; too gravelly.	Too sloping; moderate permeability.	Too sloping; medium susceptibility to piping; low compressibility.	Too sloping.
Poor for gravel: fines; unsuitable for sand.	Poor: too gravelly	Moderate permeability	Too sloping; medium susceptibility to piping; low compressibility.	Low available water capacity.
Poor for sand: fines; unsuitable for gravel.	Poor: too sandy	Moderately rapid permeability.	High susceptibility to piping; medium compressibility.	Very high hazard of erosion.
Poor for sand: fines; unsuitable for gravel.	Good	Moderately rapid permeability.	Medium shear strength; medium susceptibility to piping.	Moderate available water capacity.
Unsuitable	Good	Moderately rapid permeability.	Medium shear strength; high susceptibility to piping.	High available water capacity; frost-free season is 90 to 100 days.
Too variable to be rated.	Too variable to be rated.	Too sloping	Too variable to be rated.	Too sloping.
Unsuitable	Fair: clay at a depth of 13 inches.	Moderately slow permeability.	Moderate shrink-swell potential; low shear strength.	High available water capacity; frost-free season is 100 to 120 days.
Unsuitable	Poor: too gravelly	Moderately slow permeability.	Moderate shrink-swell potential; low shear strength.	High available water capacity; frost-free season is 100 to 120 days.
Unsuitable	Poor: less than 8 inches of suitable material.	Slow permeability	High shrink-swell potential; low shear strength.	Slow permeability.
Unsuitable	Poor: too stony	Slow permeability	High shrink-swell potential; low shear strength.	Slow permeability.

TABLE 4.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—			Suitability as source of—
	Septic tank absorption fields	Dwellings without basements	Local roads and streets	Road fill
Hubert: HUB	Moderate: moderate permeability.	Moderate: moderate frost-action potential.	Moderate: moderate frost-action potential.	Fair: moderate frost-action potential.
HUC2	Moderate: moderate permeability; too sloping.	Moderate: moderate frost-action potential; too sloping.	Moderate: moderate frost-action potential; too sloping.	Fair: moderate frost-action potential; too sloping.
*Jocity: JoB, JR, JS— For Claysprings part of JS, see Claysprings series.	Severe: moderately slow permeability.	Moderate: moderate shrink-swell potential; moderate frost-action potential.	Moderate: moderate shrink-swell potential; low shear strength.	Fair: moderate shrink-swell potential; low shear strength.
Loamy alluvial land: LO.	Severe: moderately slow permeability.	Too variable to be rated—	Too variable to be rated—	Too variable to be rated—
Luth: LuA, LuB	Severe: water table at a depth of ½ foot to 1½ feet.	Severe: water table at a depth of ½ foot to 1½ feet; high frost-action potential.	Severe: water table at a depth of ½ foot to 1½ feet; high frost-action potential.	Poor: high shrink-swell potential; water table at a depth of ½ foot to 1½ feet; high frost-action potential.
Millett: MGD	Severe: too sloping	Severe: too sloping	Severe: too sloping	Fair: too sloping
Moenkopie: MKB, MOD.	Severe: bedrock at a depth of 5 to 20 inches; too sloping.	Severe: bedrock at a depth of 5 to 20 inches; too sloping.	Severe: bedrock at a depth of 5 to 20 inches; too sloping.	Poor: bedrock at a depth of 5 to 20 inches.
Navajo: NaB, NaC, NC, NdA, NdB, NdC, NlA.	Severe: very slow permeability.	Severe: high shrink-swell potential; low shear strength.	Severe: high shrink-swell potential; low shear strength.	Poor: high shrink-swell potential; low shear strength.
Nutrioso: NT, NuA, NuB, NuC.	Severe: moderately slow permeability.	Moderate: moderate shrink-swell potential; low shear strength.	Moderate: moderate shrink-swell potential; low shear strength.	Fair: moderate shrink-swell potential; low shear strength.
*Palma: PAB, PSB— For Sheppard part of PSB, see Sheppard series.	Moderate: moderate permeability.	Slight	Slight	Good
Riverwash: RH	Severe: subject to frequent overflow; water table at a depth of 0 to 1 foot.	Severe: subject to frequent overflow; water table at a depth of 0 to 1 foot.	Severe: subject to frequent overflow; water table at a depth of 0 to 1 foot.	Poor: subject to frequent overflow; water table at a depth of 0 to 1 foot.
Rough broken land: RO	Severe: too sloping	Severe: too sloping	Severe: too sloping	Severe: too sloping
Rudd: RvB, RwF, RXB.	Severe: bedrock at a depth of 6 to 20 inches. RwF: too sloping.	Severe: bedrock at a depth of less than 20 inches. RwF: too sloping.	Severe: bedrock at a depth of 6 to 20 inches. RwF: too sloping.	Poor: bedrock at a depth of 6 to 20 inches.

See footnote at end of table.

engineering properties of the soils—Continued

Suitability as source of—Continued		Soil features affecting—		
Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Unsuitable	Poor: too gravelly	Moderate permeability	Moderate shear strength; low compressibility.	Moderate available water capacity; gravelly.
Unsuitable	Poor: too gravelly	Moderate permeability; too sloping.	Moderate shear strength; low compressibility.	Too sloping.
Unsuitable	Fair: sandy clay loam	Moderately slow permeability.	Moderate shrink-swell potential.	Moderately slow permeability; high available water capacity.
Unsuitable	Too variable to be rated	Moderately slow permeability.	Too variable to be rated	Moderately slow permeability; high available water capacity.
Unsuitable	Poor: clay at a depth of 8 inches.	Slow permeability; water table at a depth of ½ foot to 1½ feet.	High shrink-swell potential; low shear strength.	Water table at a depth of ½ foot to 1½ feet; frost-free season is 80 to 90 days.
Unsuitable	Poor: too gravelly	Moderate permeability	Moderate shrink-swell potential; medium shear strength.	Low available water capacity; too sloping.
Unsuitable	Poor: loamy sand	Bedrock at a depth of 5 to 20 inches; too sloping.	Bedrock at a depth of 5 to 20 inches; too sloping.	Bedrock at a depth of 5 to 20 inches; low available water capacity; too sloping.
Unsuitable	Poor: clay, NIA is saline-alkali affected.	Very slow permeability	High shrink-swell potential; low shear strength.	Very slow permeability. NIA is saline-alkali affected.
Unsuitable	Poor: loamy sand	Moderately slow permeability.	Moderate shrink-swell potential; high susceptibility to piping; low shear strength.	High available water capacity; moderately slow permeability; frost-free season is 90 to 120 days.
Poor: fines	Good	Moderate permeability	Medium shear strength; medium susceptibility to piping.	Moderate available water capacity; moderate permeability.
Too variable to be rated	Poor: subject to frequent overflow.	Too variable to be rated	Too variable to be rated	Subject to frequent overflow; water table at a depth of 0 to 1 foot.
Too variable to be rated	Poor: too sloping	Too sloping	Too variable to be rated	Too sloping.
Unsuitable	Poor: too gravelly; stony.	Bedrock at a depth of 6 to 20 inches. RwF: too sloping.	Bedrock at a depth of 6 to 20 inches.	Shallow to bedrock; low available water capacity; stony. RwF: too sloping.

TABLE 4.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—			Suitability as source of—
	Septic tank absorption fields	Dwellings without basements	Local roads and streets	Road fill
Sandstone rock land: SA.	Severe: bedrock at a depth of less than 20 inches.	Severe: bedrock at a depth of less than 20 inches.	Severe: bedrock at a depth of less than 20 inches.	Poor: bedrock at a depth of less than 20 inches.
Sandy alluvial land: SD.	Severe: subject to frequent overflow.	Severe: subject to frequent overflow.	Severe: subject to frequent overflow.	Fair: excessive fines.
Shay: Sh.	Severe: water table at a depth of 0 to 2 feet; slow permeability.	Severe: water table at a depth of 0 to 2 feet; high shrink-swell potential.	Severe: high shrink-swell potential; water table at a depth of 0 to 2 feet.	Poor: high shrink-swell potential: water table at a depth of 0 to 2 feet.
Sheppard: SMB.	Slight [1]	Slight	Slight	Good
Springerville: Sp, SRB.	Severe: very slow permeability; bedrock at a depth of 3 to 6 feet.	Severe: high shrink-swell potential; low shear strength.	Severe: high shrink-swell potential; low shear strength.	Poor: high shrink-swell potential; low shear strength.
Stony rock land: SU.	Severe: bedrock at a depth of less than 20 inches.	Severe: bedrock at a depth of less than 20 inches.	Severe: bedrock at a depth of less than 20 inches.	Poor: bedrock at a depth of less than 20 inches.
Thunderbird: TbC, TDB.	Severe: very slow permeability; bedrock at a depth of 20 to 30 inches.	Severe: high shrink-swell potential; bedrock at a depth of 20 to 30 inches.	Severe: high shrink-swell potential; low shear strength.	Poor: high shrink-swell potential; low shear strength.
Tours: TH, TL, TmC, TO, TrA, TrB, Tu.	Severe: moderately slow permeability.	Moderate: moderate shrink-swell potential.	Severe: low shear strength.	Poor: low shear strength.
Travertine rock land: TV.	Severe: bedrock at a depth of less than 20 inches.	Severe: bedrock at a depth of less than 20 inches.	Severe: bedrock at a depth of less than 20 inches.	Poor: bedrock at a depth of less than 20 inches.
Winona: WFB.	Severe: bedrock at a depth of 6 to 12 inches.	Severe: bedrock at a depth of 6 to 12 inches.	Severe: bedrock at a depth of 6 to 12 inches.	Poor: bedrock at a depth of 6 to 12 inches.
Ziegler:				
ZeC, ZGB.	Slight [1]	Moderate: moderate shrink-swell potential; CL material to a depth of 24 inches, GP material below that depth.	Moderate: moderate shrink-swell potential: CL material to a depth of 24 inches, GP material below that depth.	Good: source of cinders below a depth of 2 or 3 feet.
ZGE.	Severe: too sloping.	Severe: too sloping.	Severe: too sloping.	Poor: too sloping.

[1] Pollution is a hazard in places because of permeability in the substratum.

engineering properties of the soils—Continued

Suitability as source of—Continued			Soil features affecting—	
Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Unsuitable	Poor: rock outcrops	Bedrock at a depth of less than 20 inches.	Bedrock at a depth of less than 20 inches.	Bedrock at a depth of less than 20 inches.
Poor: fines	Poor: finely stratified sand to sandy loam.	Moderately rapid permeability; subject to sedimentation.	Medium shear strength; medium compacted permeability.	Moderate available water capacity; subject to frequent overflow.
Unsuitable	Poor: clay	Slow permeability; water table at a depth of 0 to 2 feet.	High shrink-swell potential; low shear strength.	Water table at a depth of 0 to 2 feet; slow permeability.
Poor for sand: fines; unsuitable for gravel.	Poor: loamy sand	Rapid permeability	Medium shear strength; medium compacted permeability.	Low available water capacity; rapid permeability.
Unsuitable	Poor: clay; cobbly	Very slow permeability; bedrock at a depth of 3 to 6 feet.	High shrink-swell potential; low shear strength.	Very slow permeability; moderate available water capacity.
Unsuitable	Poor: too stony	Bedrock at a depth of less than 20 inches.	Bedrock at a depth of less than 20 inches.	Bedrock at a depth of less than 20 inches; extremely stony.
Unsuitable	Poor: clay; cobbly	Very slow permeability; bedrock at a depth of 20 to 30 inches.	High shrink-swell potential; low shear strength.	Very slow permeability; low available water capacity.
Unsuitable	Fair: clay loam. Poor for Tu: saline-alkali.	Moderately slow permeability.	Moderate shrink-swell potential; medium shear strength.	Moderately slow permeability; high available water capacity. Tu is saline-alkali affected.
Unsuitable	Poor: rocky	Bedrock at a depth of less than 20 inches.	Bedrock at a depth of less than 20 inches.	Bedrock at a depth of less than 20 inches.
Unsuitable	Poor: limited thickness	Bedrock at a depth of 6 to 12 inches.	Bedrock at a depth of 6 to 12 inches.	Bedrock at a depth of 6 to 12 inches.
Unsuitable	Poor: gravel	Rapid permeability below a depth of 2 or 3 feet.	High compacted permeability; low compressibility.	Moderate available water capacity; moderately slow permeability; frost-free season is 80 to 90 days.
Unsuitable for sand; good for gravel: cinders.	Poor: gravel	Too sloping	High compacted permeability; low compressibility; too sloping.	Too sloping.

TABLE 5.—*Engineering*

[Tests performed by the Materials Division of the Arizona Highway Department in accordance with standard procedures of the

Soil name and location	Depth from surface	Moisture-density data [1]		Mechanical analysis [2]		
		Maximum dry density	Optimum moisture	Percentage passing sieve—		
				1 in	¾ in	⅜ in
Clovis sandy clay loam, thin solum:	*Inches*	*Lb per cu ft*	*Percent*			
SE¼ sec. 30, T. 13 N., R. 28 E. (Nonmodal: thinner surface layer and subsoil)	3–10	112	14. 1	100	99	97
	10–32	120	11. 5	--------	100	98
	32–40	121	12. 0	--------	100	99
	40–60	113	15. 4	--------	100	99
Navajo clay, saline-alkali:						
2,640 feet south of the northeast corner of sec. 33, T. 15 N., R. 25 E. (Modal)	0–24	87	32. 0	--------	--------	--------
	24–44	93	27. 6	--------	--------	--------
	44–72	85	32. 4	--------	--------	--------

[1] Based on AASHO Designation T 99–57, Method A (*1*).

[2] Mechanical analyses according to the AASHO Designation T 88–57 (*1*). Results by this procedure may differ somewhat from the results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from the calculations of grain-size fractions. The mechanical analyses data used in this table are not suitable for use in naming textural classes of soil.

Soil limitations are indicated by the ratings slight, moderate, and severe. A rating of *slight* means soil properties are generally favorable for the rated use, or in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. A rating of *severe* means soil properties are so unfavorable and so difficult to correct or overcome that they require major soil reclamation, special design, or intensive maintenance.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 4.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Dwellings, as rated in table 4, are no more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to its capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect the capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Local roads and streets, as rated in table 4, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect the design and construction of roads and streets are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 4 provide guidance about where to look for probable sources. A soil rated

test data

American Association of State Highway Officials (AASHO). Absence of an entry indicates that no determination was made]

Mechanical analysis[2]—Continued							Liquid limit [3]	Plasticity index [4]	Classification	
Percentage passing sieve—Continued				Percentage smaller than—						
No 4 (4.7 mm)	No 10 (2.0 mm)	No 40 (0.42 mm)	No 200 (0.074 mm)	0.02 mm	0.005 mm	0.001 mm			AASHO [5]	Unified [6]
95	91	71	35	30	27	--------	42	30	A-2-7(4)	SC
96	91	69	33	22	20	--------	30	17	A-2-6(1)	SC
97	87	38	17	14	12	--------	38	25	A-2-6(0)	SC
98	95	72	35	28	23	--------	39	27	A-2-6(3)	SC
----------	----------	100	99	100	98	78	102	82	A-7-6(20)	CH
----------	----------	100	99	--------	59	45	73	57	A-7-6(20)	CH
----------	----------	----------	100	--------	94	77	106	85	A-7-6(20)	CH

[3] Based on AASHO Designation T 89-60 (*1*).
[4] Based on AASHO Designation T 90-56 and AASHO Designation T 91-54 (*1*).
[5] Based on AASHO Designation M 145-49 (*1*).
[6] Based on ASTM Designation D 2487-66 T (*4*).

as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate the quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants grown on it when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and the content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils that are suitable for pond reservoir areas have low seepage, which is related to permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among the unfavorable factors.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Engineering test data

Table 5 contains engineering test data for some of the major soil series in Apache County, Central Part. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications shown are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction (or moisture-density) data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases as moisture content increases. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 3.

How the Soils of Apache County, Central Part, Were Formed and How They are Classified

This section discusses the major factors of soil formation as they relate to the soils of Apache County, Central Part, and briefly explains the system of classifying soils into categories broader than the series. It also contains data

obtained by physical and chemical analyses of five selected soils.

Factors of Soil Formation

The factors that determine the kind of soil that forms at any given point are: (1) the composition of the soil parent material; (2) the climate under which the soil material accumulated or weathered; (3) the plants and animals on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material.

Climate and living matter are the active factors of soil formation. They alter the soil material and bring about the development of genetically related horizons. Relief, mainly by its effect on temperature and runoff, modifies the effect of climate and living matter. The parent material affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into a soil. Usually a long time is required for the development of distinct horizons. All soils reflect the interaction of the five soil-forming factors.

Parent material

To an observer of the soils in Apache County, Central Part, it is obvious that the parent material has had a pronounced effect on the kinds of soils formed.

Moenkopie soils are reddish in color, as are the parent material in which they formed. The reddish-colored sandstone inhibits penetration by water and roots and, therefore, weathers very slowly. Removal of soil material from the surface by erosion and soil blowing almost keeps pace with soil formation, resulting in shallow and very shallow soils. In contrast, Clovis and Palma soils formed in weakly consolidated, gravelly alluvium that is easily penetrated by water and plant roots. These soils also have colors inherited from their parent material, but they are deep.

The Rudd, Springerville, and Thunderbird soils all formed in place on basalt parent rock. The Springerville and Thunderbird soils are clayey and moderately deep or deep, whereas the Rudd soils are loamy and shallow. One explanation for the difference in depth and texture is that the Rudd soils formed under a drier climate, resulting in less soil development.

The Bandera soils formed in material weathered from basaltic cinders, resulting in porous soils that have low bulk density.

The soils of the survey area that are on flood plains or fans directly reflect the texture and nature of the parent alluvium in which they formed. The Navajo soils are clay and formed in clay alluvium deposited by very slow moving or still floodwater. The reddish-gray Jocity soils are sandy clay loam and formed in sandy clay loam alluvium that was derived from reddish-gray shale and was deposited mainly by slow-moving water from side drainageways forming fans that have slopes of as much as about 3 percent. The Eagar soils are loam and gravelly loam and formed on fans that have slopes generally of 2 to 10 percent. The gravelly and cobbly fan materials were deposited by rapidly moving water, whereas the loamy top materials were deposited after the gradient of the stream had been lowered and the waters somewhat slowed.

The varicolored Badlands, known locally as Painted Desert, are shale exposures that, because of a combination of such factors as slope, erodibility, and soil material, do not allow the penetration of water and roots and, therefore, remain relatively unweathered. The thin layer of surface material that does start to weather is immediately removed by soil blowing or erosion.

Climate

Climate affects soil formation through its influence on vegetation, on weathering, and on runoff and erosion. The main climatic factors that affect soil formation are precipitation and temperature. For the purpose of this discussion, it is assumed that the present climate is similar to the climate under which these soils formed.

The climate in this survey area is highly varied considering the acreage of land involved. The area around Saint Johns and northward has a steppe climate of mild summers and chilly winters. Two-thirds of the annual precipitation falls from May to October. The average annual precipitation is about 11 inches. The average annual temperature is 52° F., the average temperature in July is 73°, and the average temperature in January is 31°. The frost-free season averages about 140 days. In contrast, the area in the vicinity of Alpine has a cold temperate climate of cool summers and cold winters. Almost half the annual precipitation falls during July, August, and September. The average annual precipitation is nearly 20 inches. The average annual temperature is 43°, the average temperature in July is 60°, and the average temperature in January is 26°. The frost-free season averages about 85 days. A transitional zone between the steppe and cold temperate climates is manifest in the area around Springerville. For more detailed climatic information, see the "Climate" section of this soil survey.

The vegetation increases in density as the available moisture increases. In the well-drained soils on uplands, the amount of water available to plants, as well as the depth to which the soils are leached, are affected by total precipitation, temperature, and, to some extent, exposure. On the flood plains, in such soils as those of the Shay series, the amount of water available also is affected by a high water table. Consequently, the vegetation is considerably more dense than on other soils.

As precipitation increases, the hazard of erosion increases. In this survey area, however, the areas that have the highest precipitation also have good vegetative cover, and this reduces the erosion hazard. Conversely, the areas that have the lowest precipitation have less vegetative cover, resulting in an increased erosion hazard when rainfall is intense.

Precipitation affects the rate of weathering because water is the medium in which chemical reactions take place and is the principal agent of weathering. If the depth of moisture penetration is limited or water is insufficient to carry away the end products of chemical reactions, weathering is slowed and may be temporarily stopped.

High summer temperature accelerates the formation of soils because it hastens the weathering of soil material and the decomposition of humus. In this survey area the effects of high temperature are further modified because those soils that are in the area of highest summer temperature

receive only about 6 to 8 inches of precipitation during summer.

The greatest amount of moisture and the coolest temperatures are in the higher southern areas in and near the mountains. These factors favor the formation of such soils as the Cambern and Clover Springs soils, which contain 3 to 4 percent organic matter and are slightly acid to neutral in the upper 10 inches. Soils in the hotter, drier part of the survey area, such as the Petrified Forest National Park, show the least amount of development. Examples are the Moenkopie and Jocity soils, which contain about 1 percent organic matter and are moderately alkaline to strongly alkaline.

Soils that have intermediate profile development and intermediate amounts of organic matter are present in the transitional area between the mild, dry parts and the cool, humid parts of the survey area.

Plants and animals

Vegetation has played a larger role in the breakdown and weathering of soil material in Apache County, Central Part, than have other living organisms. The Hubert soils, however, show evidence of burrowing by numerous cicadas. This burrowing results in long, narrow tunnels that are filled with dark-colored material from the surface layer and extend into the subhorizons. Related to the presence of cicadas and other insects is evidence of much activity by burrowing animals, such as insect- and root-eating skunks. This burrowing has created what almost amounts to a plow layer in most areas of the Hubert soils.

Plants draw moisture and nutrients from the soil, intercept runoff, reduce erosion, and improve aeration and permeability. The remains of dead plants replenish the content of organic matter in the soil. Roots of growing plants, especially shrubs and trees, actually fracture bedrock and open cracks into it, and this speeds the weathering process.

A luxuriant stand of water-tolerant grasses and sedges grows on the poorly drained Shay soils. Consequently, these soils are darker colored than other soils in the survey area and, except for forested soils, contain more organic matter. They contain an average of about 3 percent organic matter in the upper 20 inches.

The amount of vegetation on well-drained upland soils and, to a large extent, the kind of vegetation—whether dominantly grass or dominantly trees—are directly related to the amount of precipitation. Moenkopie soils, for example, are at lower elevations where the average annual precipitation is less than 10 inches. They have a sparse cover of grass, such as galleta, blue grama, and alkali sacaton, and some shrubs. The organic-matter content of the A horizon of these soils is less than 1 percent. Clovis and Hubert soils are at the middle elevations where the average annual precipitation is 10 to 16 inches. They have a somewhat more dense cover of grasses, such as black grama, Indian ricegrass, and blue grama, and shrubs, such as chamiza, winterfat, and horsebrush. Juniper invades these soils if the grass is depleted. The organic-matter content of the A horizon of these soils is about 1 to 3 percent. Cambern and Ziegler soils are at higher elevations where the average annual precipitation is 25 inches. They have a vegetative cover of grass and juniper, pinon pine, and ponderosa pine. The organic-matter content of the A horizon of these soils is about 3 to 5 perecnt.

Relief

The effects of topography upon soil weathering processes in Apache County, Central Part, can be separated into two categories. First is the gross relief of the survey area, which has a profound effect on climate and vegetation. The direct correlation between elevation and precipitation is discussed in the sections on climate and biological activities. Second is the local relief that is characteristic of each soil series. The Clovis, Palma, and Sheppard soils formed in similar parent material and under the same climate, but each has a different position on the landscape. Clovis soils are nearly level and sometimes in swales. Runoff is slow, and soils receive additional water from the adjacent Palma and Sheppard soils. They exhibit more profile development and have more distinct horizons than those related soils. Sheppard soils occupy higher positions and have steep, dunelike slopes. They have been weathering for a short length of time. They show very little profile development and practically no horizonation. Palma soils lie between soils of the other two series on the landscape and have intermediate slopes. They exhibit a degree of profile development and horizonation that is about halfway between the Clovis and Sheppard soils.

Time

A long time is generally required for soil formation. The length of time necessary depends on the influence of the other four major factors of soil formation. Large differences in climate, topography, vegetation, and parent material occur in this survey area. As a result, the length of time necessary for soil formation varies considerably from the warmer, drier northern part of the survey area to the cooler, more moist southern part.

The Navajo, Jocity, and Tours soils formed in recently deposited alluvial material on flood plains and alluvial fans and show little profile development. Only a weak A horizon is present because of the climatic and biological factors in the warmer, drier northern part of the survey area. The Moenkopie soils formed in some of the older geologic material in the survey area, the Moenkopie Formation, but these are young soils in profile development because the Moenkopie Formation is hard, fine-grained sandstone that is relatively resistant to weathering. Consequently, the material weathers slowly and soil removal essentially keeps pace with soil development. Thunderbird soils, by contrast, show strong profile development. They are located in the cooler, more moist southern part of the survey area on relatively recent basalt flows that tend to weather readily. Climate, biologic factors, and parent material all contribute to the relatively rapid development of these soils.

The effect of climate and biologic factors on soil formation in Apache County, Central Part, is illustrated by the fact that the organic-matter content of the soils in the warmer, drier part of the survey area is less than 1 percent, whereas that of soils in the cooler, more moist part ranges to as much as 5 percent. Profiles are least developed in the warmer, drier part of the survey area and most developed in the cooler, more moist part. Intermediate areas that are between the extremes previously mentioned, such as the Springerville area, have soils that are intermediate in development, such as the Eagar and Hereford soils.

The influence of topography is well illustrated by the Bandera soils. These soils are associated with the Thunderbird soils, formed in similar material of approximately the same age, and have essentially the same vegetative cover. Bandera soils have slopes ranging to as much as 60 percent, but the Thunderbird soils have slopes generally of less than 5 percent. On the steeper slopes a great deal of the moisture necessary to soil formation is lost through runoff. This results not only in less moisture for soil development, but also in removal of soil material from the surface of the developing soil by erosion. Thus, the Bandera soils have a relatively thin profile and no B horizon.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (3). Because this system is under continual study, readers interested in developments of the current system should refer to the latest literature available.

The current system of classification has six categories. Beginning with broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen so that soils of similar genesis, or mode of origin, are grouped. In table 6, the soil series of Apache County, Central Part, are placed in four categories of the current system. Classes of the current system are briefly described in the following paragraphs.

ORDER.—Ten soil orders are recognized: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions, the Entisols and Histosols, occur in many different climates. Each order is named with a word of three or four syllables, ending in *sol* (Ent-i-sol). The four soil orders represented in Apache County, Central Part, are Aridisols, Entisols, Mollisols, and Vertisols.

TABLE 6.—*Classification of the soils*

Series	Family	Subgroup	Order
Bandera	Cindery	Torriorthentic Haploborolls	Mollisols.
Bushvalley	Loamy-skeletal, mixed	Argic Lithic Cryoborolls	Mollisols.
Cambern	Fine-loamy, mixed	Argic Pachic Cryoborolls	Mollisols.
Claysprings	Clayey, montmorillonitic (calcareous), mesic, shallow	Typic Torriorthents	Entisols.
Clover Springs	Fine-silty, mixed	Cumulic Cryoborolls	Mollisols.
Clovis	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Eagar	Loamy-skeletal, mixed	Typic Calciborolls	Mollisols.
Fruitland	Coarse-loamy, mixed (calcareous), mesic	Typic Torriorthents	Entisols.
Fruitland, cold variant.	Coarse-loamy, mixed (calcareous), frigid	Typic Torriorthents	Entisols.
Hereford	Fine-loamy, mixed	Pachic Argiborolls	Mollisols.
Hereford, heavy variant.	Fine, mixed	Pachic Argiborolls	Mollisols.
Hubert	Loamy-skeletal, mixed, mesic	Typic Calciustolls	Mollisols.
Jocity	Fine-loamy, mixed (calcareous), mesic	Typic Torrifluvents	Entisols.
Luth [1]	Fine, mixed	Typic Cyroborolls	Mollisols.
Millett	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Moenkopie	Loamy, mixed (calcareous), mesic	Lithic Torriorthents	Entisols.
Navajo	Fine, mixed (calcareous), mesic	Typic Torrifluvents	Entisols.
Nutrioso	Fine-loamy, mixed	Cumulic Haploborolls	Mollisols.
Palma	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Rudd	Loamy, skeletal, mixed, mesic	Lithic Calciustolls	Mollisols.
Shay [1]	Fine, montmorillonitic, mesic	Cumulic Haplustolls	Mollisols.
Sheppard	Mixed, mesic	Typic Torripsamments	Entisols.
Springerville	Fine, montmorillonitic, mesic	Typic Chromusterts	Vertisols.
Thunderbird	Fine, montmorillonitic, mesic	Typic Argiustolls	Mollisols.
Tours	Fine-silty, mixed (calcareous), mesic	Typic Torrifluvents	Entisols.
Winona	Loamy, carbonatic, mesic	Lithic Torriorthents	Entisols.
Ziegler	Clayey over fragmental, montmorillonitic, mesic	Typic Argiustolls	Mollisols.

[1] The Luth and Shay soils in this survey area are taxadjuncts to their respective series, because they are more poorly drained than is defined for the series. The Luth soils are classified in the survey area as a member of the fine, mixed family of Typic Cryaquolls, and the Shay soils, as a member of the fine, montmorillonitic (calcareous), mesic family of Cumulic Haplaquolls.

SUBORDER.—Each order is divided into suborders, primarily on the basis of those soil characteristics that seem to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences that result from climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is Orthent.

GREAT GROUP.—Each suborder is separated into great groups on the basis of uniformity in kind and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Torriorthent.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) segment of the group and others, called intergrades, made up of soils that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Torriorthent.

FAMILY.—Soil families are established within a subgroup primarily on the basis of properties important to plant growth or on the behavior of soils when they are used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae. An example is the coarse-loamy, mixed (calcareous), frigid family of Typic Torriorthents.

SERIES.—The series has the most narrow range of the categories in the classification system. It is explained in the section "How This Survey Was Made."

Laboratory Analyses

In this section, the results of the physical and chemical analyses of soils conducted in the Soil Survey Laboratory, Riverside, California, are shown in table 7 and methods of analysis are briefly discussed. Data for these soils were taken from the general site location for the series and are described in the section "Descriptions of the Soils." Each profile was sampled in two or more places, but the results were similar and data are therefore shown for only one profile.

Methods of Analysis

Each sample was air dried, and the clods were broken up with a wooden rolling pin and screened through a 2-millimeter, round-holed sieve. Coarse fragments larger than 2 millimeters were weighed to determine the gravel content and then discarded.

Size class and particle diameter.—Organic matter was destroyed by using hydrogen peroxide, and the sample was dispersed with sodium metaphosphate. The sand fraction was separated from the silt and clay by screening with a 300-mesh sieve. It was further screened through a nest of sieves to determine individual sand fractions. Silt and clay were determined by the pipette method.

Linear extensibility.—The change in the vertical dimensions of the natural fabric of a soil was measured in going from an oven-dry to a moist state (⅓-bar). Linear extensibility of the natural fabric approximates the change in volume the same soil would undergo as it became wet if it had been compacted and used as a foundation, since the wider range in moisture content (oven-dry to field capacity) of the laboratory sample compensates for the higher density of the compacted foundation material.

Bulk density, ⅓-bar.—Values were obtained by collecting natural clods, dipping them in a solution of saran resin that had been dissolved in methyl ethyl ketone, and measuring the displacement when a saran-coated clod was dipped in water. Corrections were made for coarse fragments more than 2 millimeters in diameter.

Reaction.—Soil reaction, expressed as a pH value, was measured with a glass electrode pH meter as a saturated paste and at a 1:1 water ratio.

Exchangeable sodium percentage.—The exchangeable sodium percentage, or the degree of saturation of the exchange complex with sodium, is a value derived by dividing the exchangeable sodium by the cation exchange capacity (NH_4OAC) and multiplying the result by 100.

Extractable bases.—The soil sample was saturated and leached with ammonium acetate. The leachate was analyzed for calcium and magnesium by atomic adsorption. Potassium and sodium were analyzed by flame photometry.

Electrical conductivity.—An extract was drawn from a saturated paste. Conductivity of the saturation extract was determined with a conductivity bridge and conductivity cell. Readings were converted to millimhos per centimeter after correcting to 25° C., using a standard table.

Water content.—The determination was made with a pressure plate on a natural clod coated with saran for one-third bar and using a pressure membrane extraction on sieved samples for 15 bars.

Organic carbon.—The percentage of organic carbon was determined by acid dichromate digestion and ferrous sulfate titration.

Carbonate as $CaCO_3$.—Calcium carbonate was determined by measurement of CO_2 gas given off from the acidification of soil samples with HCl.

Cation exchange capacity.—The soil sample was saturated and leached with an ammonium acetate solution. Water, granular zinc, and 1N NaOH were added to the sample and distilled into a 4 percent boric acid solution. The solution was then titrated with hydrochloric acid.

TABLE 7.—*Laboratory*

[Analyses by Soil Survey Laboratory, Riverside, Calif.; x indicates element looked for, but not found; xx=trace;

Soil and report number	Horizon	Depth from surface	Size class and particle diameter [1]								Coarse fragments		
			Total			Sand							
			Sand (2.0–0.05 mm)	Silt (0.05–0.002 mm)	Clay (<0.002 mm)	Very coarse (2.0–1.0 mm)	Coarse (1.0–0.5 mm)	Medium (0.5–0.25 mm)	Fine (0.25–0.1 mm)	Very fine (0.1–0.0 mm)	<2 mm	2–19 mm [2]	19–76 [2] mm
		In									*Pct*	*Pct*	*Pct*
Bandera gravelly loam: S65Ariz–1–19	A11	0–2	41.9	44.8	13.3	8.8	9.1	5.1	10.2	8.7	32	32	0
	A12	2–9	35.3	47.9	16.8	8.0	7.9	4.1	8.4	6.9	34	33	1
	C1	9–19	47.0	41.9	11.1	11.7	12.7	5.6	9.9	7.1	51	39	7
	IIC2ca	19–36	------	-------	-------	-------	-------	-------	------	------	100	------	------
	IIC3	36–60	------	-------	-------	-------	-------	-------	------	------	100	------	------
Clovis loamy sand: S65Ariz–1–8	A1	0–3	88.5	7.0	4.5	1.4	15.5	24.6	36.1	10.9	x	x	x
	B1	3–8	79.8	8.6	11.6	1.3	11.4	20.4	34.5	12.2	x	x	x
	B21	8–16	66.1	6.7	27.2	1.0	8.8	18.5	30.3	7.5	x	x	x
	B22ca	16–24	59.0	13.9	27.1	1.2	10.2	17.2	25.3	5.1	x	x	x
	B3ca	24–30	48.2	22.9	28.9	1.3	8.5	12.4	21.5	4.5	x	x	x
	IIC1	30–58	88.7	4.4	6.9	2.2	18.9	30.0	32.2	5.4	x	x	x
	IIIC2ca	58–64	74.1	10.5	15.4	1.2	19.0	28.9	21.4	3.6	x	x	x
	IVC3	64–76	84.4	6.3	9.3	2.3	21.1	29.4	26.5	5.1	4	4	x
Palma loamy sand: S65Ariz–1–10	A1	0–3	92.5	3.3	4.2	2.1	19.1	22.2	44.1	5.0	x	x	x
	B1	3–5	90.2	2.5	7.3	1.8	17.5	20.8	44.8	5.3	x	x	x
	B2t	5–12	84.4	3.2	12.4	.7	12.4	18.1	46.9	6.3	x	x	x
	B3	12–21	87.0	3.5	9.5	.1	2.5	10.6	65.9	7.7	x	x	x
	Cca	21–41	88.1	3.2	8.7	.1	.5	5.4	70.4	11.7	x	x	x
	IIB21cab	41–54	81.1	6.7	12.2	2.0	10.3	18.0	42.4	8.4	x	x	x
	IIB22b	54–62	83.5	5.8	10.7	1.8	17.2	24.3	35.5	4.7	1	1	x
	IIB3ca	62–73	79.6	5.3	15.1	1.1	13.1	27.1	34.5	3.8	x	x	x
	IIIC2	73–79	93.4	2.1	4.5	.7	15.4	41.6	32.6	3.1	x	x	x
Rudd gravelly loam: S65 Ariz–1–20	A11	0–2	57.0	26.5	16.5	6.8	17.5	11.8	13.7	7.2	47	12	21
	A12	2–10	41.1	29.1	29.8	3.1	9.1	8.4	12.5	8.0	47	12	21
	C	10–13	44.2	27.4	28.4	6.6	11.7	8.2	11.2	6.5	27	------	------
		13–24	------	-------	-------	-------	-------	-------	------	------	------	------	------
Sheppard loamy sand: S65 Ariz–1–1	A1	0–10	96.2	2.1	1.7	.1	11.2	33.6	44.7	6.6	x	x	x
	C1	10–25	96.0	1.3	2.7	.4	14.9	36.5	39.8	4.4	x	x	x
	C2	25–40	95.9	1.5	2.6	.4	13.7	34.8	43.5	3.5	x	x	x
	C3	40–70	93.5	2.0	4.5	.5	2.2	21.0	62.5	7.3	x	x	x

[1] Based on percentage of particles 2 millimeters in size.

analyses of selected soils

dashes indicate that tests were not made. The symbol > means more than; the symbol < means less than]

Coefficient of linear extensibility (COLE)	Bulk density ⅓-bar	Reaction		Exchangeable sodium	Extractable bases (milliequivalents per 100 grams of soil)				Electrical conductivity	Water content		Organic carbon	C/N	Carbonate as $CaCO_3$	Cation exchange capacity NH_4OAC
		Saturated paste	1:1 H_2O		Ca	Mg	Na	K		⅓-bar	15-bar				
In per in	*Gm per cc*	*pH*	*pH*	*Pct*					*Mmhos per cm at 25° C*	*Pct*	*Pct*	*Pct*		*Pct*	*Meq per 100 gm*
			7.2		19.3	6.3	0.4	0.4			12.8	2.23	13	x	28.9
0.006	0.96		7.5		31.5	10.4	.5	.7		25.4	16.7	3.03	12	x	44.7
		7.4	8.4	7	29.4	16.8	3.2	.6	1.83		16.0	2.13		6	37.1
.004	1.75		7.5	4	4.5	.6	.2	.3		5.0	2.5	.41	15	x	4.9
.017	1.68		7.5	3	6.2	2.0	.3	.2		10.0	4.4	.32	10	x	8.6
.030	1.54		7.4	3	13.2	5.4	.6	.5		16.4	11.2	.52		x	20.6
.027	1.50		8.4	5	23.3	5.6	.8	.4		16.4	10.3	.37		10	17.5
.020	1.33	7.8	8.5	7	20.9	5.2	1.1	.3	.71	23.6	10.7	.41		23	14.7
.010	1.79	7.5	8.2	12	13.2	1.9	.7	.1	3.22	5.8	2.9	.10		3	5.2
.018	1.62	7.5	7.9	8	19.4	3.0	1.6	.3	5.16	12.3	6.2	.13		7	10.6
		7.6	8.0	18	14.2	1.9	1.9	.2	4.39			.10		3	7.8
			8.0	4	6.2	.3	.2	.2			2.3	.23	18	x	4.9
.007	1.70		7.5	3	6.1	1.2	.2	.2		4.5	3.4	.34	20	x	7.4
.016	1.63		6.9	3	8.9	1.8	.5	.2		8.5	5.3	.27		x	11.3
.014	1.54		7.9	2	13.7	1.5	.2	.2		7.1	4.5	.21		xx	8.2
.008	1.56		8.3	4	17.6	1.9	.3	.2		6.9	4.0	.12		3	7.8
.008	1.70		8.4	4	17.4	2.0	.4	.2		8.1	5.5	.16		5	11.3
.013	1.70	7.9	8.5	5	17.9	2.1	.5	.2	.42	7.4	4.4	.10		3	8.3
.029	1.66	7.9	8.5	5	21.5	2.9	.6	.2	.42	9.5	5.3	.19		4	10.7
		8.4	8.6	10	6.7	.9	.5	.1	.32		1.9	.06		xx	4.2
			8.0		26.1	2.3	.3	.9			9.3	1.47	12	7	24.3
	1.13		8.0		33.2	2.3	.3	.7		26.3	16.1	2.09	9	22	30.1
			8.0		24.8	1.9	.3	.4			16.0	2.43		40	25.0
														7	
			6.9		2.0	.7	.2	.3			1.6	.23	16	x	2.3
			7.0		2.5	.6	.3	.3			1.7	.21		x	3.0
			7.1		2.2	.4	.2	.2			1.6	.14		x	2.8
			7.3		3.5	.6	.2	.2			2.1	.11		x	4.0

[2] Based on percentage of fragments less than 7.6 millimeters in size.

Additional Facts About the Survey Area

This section discusses the transportation and industries, water, early history and development, organization and population, and climate of Apache County, Arizona, Central Part.

Transportation and Industries

In the northern part of the survey area, the land slopes southward to the Little Colorado River and northwestward to the Puerco River from a high point that extends diagonally southwestward across the area between the two rivers. The parts of Apache County that are covered by this survey are served by five State and Federal highways. One of the five, U.S. Highway 60, was the first coast-to-coast highway in the nation. One bus line serves the southern part of the survey area, and two serve the extreme northern part. One railroad crosses the extreme northern part of the survey area.

Lumber processing and cattle raising are the principal industries. In recent years several wildcat wells have been drilled as a result of increased interest in oil and gas exploration in the central part of Apache County. Several wells in the northern part of the survey area, near Navajo, produce gas that contains a high percentage of helium from the Coconino Sandstone. There is a helium-processing plant at Navajo. The U.S. Forest Service has a large office in Springerville that provides a good-sized payroll for the southern part of Apache County. Accommodations for tourists are becoming an important source of revenue. Interest in cabin sites and land speculation are responsible for increased land values.

The nearest marketing centers are Albuquerque, New Mexico; Phoenix, Arizona; and Los Angeles, California.

The three high schools in the survey area are the Springerville-Eagar (Round Valley) High School, St. Johns High School, and Sanders High School. Hospitals are located in Springerville and St. Johns.

Water

In this section the supply of ground water, the quality of the water, and the availability of water for irrigation are discussed (*5*). Water for domestic and livestock use outside the Hunt and Saint Johns areas comes from wells that vary in depth from 0 to about 800 feet and, in general, yield less than 50 gallons per minute. However, several springs that issue from volcanic flow rocks yield enough water to be used for irrigation.

The quality of the water is closely related to the stratigraphic units; the differences in quality of water from formation to formation generally are greater than they are from place to place in a formation. A notable exception is the Coconino Sandstone, which generally contains water of fair to good quality in areas to the south of the Little Colorado River and water of poor quality to the north.

Irrigation water is essential for cultivated crops below elevations of approximately 7,000 feet. In the subhumid areas above 7,000 feet, dryfarming is done in scattered localities where soils and slopes are favorable. However, yields are erratic and crop failure is frequent. Only where there is a dependable water supply for irrigation is there dependable farming.

Water for irrigation in the area of Round Valley (Springerville-Eagar) comes from the Little Colorado River, Nutrioso Creek, mountain reservoirs, and a few deep wells. It is good-quality water.

Water for irrigation in the area of Saint Johns comes from Lyman Dam on the Little Colorado River and springs in the area of Salado. The water from Lyman Dam is of good quality, but that from the springs is of doubtful quality because the salt content is high.

Concho gets its irrigation water from a reservoir below Concho Springs, and the water is of good quality.

Irrigation water for the Hunt area comes from a reservoir and diversions on the Little Colorado River and from wells. The river water is of good quality. Much of the well water is of doubtful to poor quality because the salt content, particularly chlorides, is high. Some of the wells produce good-quality water.

Early History and Development [4]

The history of farming on the upper Little Colorado River started with the Indians. Corncobs and primitive corn grinders can still be found, and prehistoric irrigation ditches can be traced on the Little Colorado River and its tributaries. Even today, some of these ditches can still be identified for miles. Why the Indians left is a mystery, as is the date of their leaving. Most archeologists think it was in the early part of the 12th Century, about the time of the "big drought" that prevailed throughout the southwest. At the coming of the first white settlers, no Indians lived anywhere on the upper reaches of the Little Colorado River, nor was there ever a serious Indian raid at any time thereafter.

Coronado in 1540 apparently was the first European visitor, but he left no mark to bear record of his passing. Mountain men and explorers no doubt passed this way, but of them there is only speculation.

In the early part of the Civil War, Tony Long, a civilian scout for Union troops, passed this way in pursuit of Confederate soldiers. He liked the region so well that he later returned with other settlers. The late 1860's saw the coming of the first permanent settlers. Many of these first settlers were of Spanish descent and brought with them large flocks of sheep. These flocks were the main source of revenue for many years. Concho was the leading town for the large sheep holdings. Several short irrigation ditches were constructed in the region. In addition to food grains and gardens, oats were grown for cavalry horses at the newly established Fort Apache.

This same time saw the coming of the first trail herds of longhorn cattle, and with them came the outlaws who for many years had almost complete control of the area. Opposing the outlaws was one of Arizona's most courageous sheriffs, Commodore Perry Owens. Local people give him credit for enabling the settlers to stay.

The middle 1870's saw the coming of the first Mormons. In their search for more land and water, they bought many

[4] By MILO WILTBANK, Eagar, Arizona, local historian.

of the existing water rights. With time the crops became diversified, but the only cash crop was oats for Fort Apache. A prime interest to all the settlements was which communities would get the oat and beef contracts.

Soon after 1918 sheep started to decline in number, and they now contribute little to the economy. Cattle raising and lumber processing are of primary economic importance to the region at present, and irrigated crops are used to bolster the cattle industry.

Organization and Population

The first Arizona Territorial government was organized December 29, 1863, at Navajo Springs near the present site of Navajo, Arizona. On February 24, 1879, Apache County was created out of Yavapai County, which was one of the four original counties in Arizona. In 1881 that part of Apache County between the Black and Gila Rivers was cut off to form part of what is now Graham and Greenlee Counties. In 1895 Apache County lost nearly half its area when its western part was formed into Navajo County.

Saint Johns was made the county seat in 1879, but in 1880 Springerville was named county seat. In 1882 Saint Johns again became the county seat and remains so to date.

Most of the population of Apache County is in the towns and settlements. The bulk of the people employed in agricultural pursuits travel back and forth from their homes to work their outlying farms and ranches. Until 1940 there was a general increase in the population of the smaller settlements, but since then the trend has been toward the larger towns.

The population of Apache County averages less than three persons per square mile, but in the survey area the average is probably even less. The only communities of size are Springerville-Eagar, which has a combined population of 2,317; Saint Johns, which has a population of 1,320; and Alpine, which has a population of approximately 500, based on the 1970 census report. The rest of the population lives at a few widely scattered ranches and at tourist centers along U.S. Highway 66.

The population of the towns near the White Mountains temporarily more than doubles during the summer vacation months, as the Apache National Forest becomes increasingly more popular for camping, hunting, and fishing.

Climate [5]

The climate of the survey area is surprisingly varied (*6*), considering the relatively small size of the area. Most of these variations are a result of the terrain in this part of the State. Generally, the survey area is divided into three broad climatic regions: (1) a steppe climate on the Arizona plateau in the northern part, (2) a transitional zone in the central part, and (3) a cold temperate climate in the mountains to the south. A fourth zone, a cold snow forest climate, exists above elevations of about 9,000 feet in the mountains, but is not discussed here because it is above existing farming areas.

[5] By PAUL C. KANGIESER, climatologist for Arizona, National Weather Service, U.S. Department of Commerce.

Because of these differences it is not possible to treat the climate of the entire survey area as an entity. Instead, after a brief description of conditions as a whole, the climate of each of the three sections is described separately, using a key station in each section as a model.

In general, this part of Arizona has nearly two-thirds of its annual precipitation in summer, or from May to October. The source of moisture for the precipitation in each of the two precipitation seasons is quite different (*7*). The moisture for summer precipitation usually comes from the Gulf of Mexico. This moisture first appears at high elevations near the end of June. By early July it reaches lower levels, and its depth usually becomes sufficient to produce thundershowers over this part of the State. This thunderstorm activity normally persists through September, when a relatively drier period ensues until the appearance of moisture from the Pacific Ocean near the end of November or early in December. This winter precipitation usually comes intermittently through March or sometimes April and is followed by relatively dry months in May and most of June. Thus, the Gulf of Mexico is the source of summer precipitation, and the Pacific Ocean that of winter precipitation. However, once or twice during summer, heavy rains may fall from air that was associated with a tropical storm in the Pacific Ocean.

Temperature and precipitation data for three stations are shown in table 8. Probabilities of last freezing temperatures in spring and first in fall are shown in table 9.

Steppe climate (*Saint Johns*).—The vast plateau of northeastern Arizona has a relatively dry steppe climate. Saint Johns is near the southern edge of this large area and does not receive enough average annual precipitation to make crop growing profitable without irrigation. Also, the seasonal distribution is unfavorable for dryfarming, because winter precipitation, which is of greatest benefit to many crops, is usually light. The storms that reach Saint Johns in the cooler months have usually lost much of their moisture over the Mogollon Plateau to the west and south. Fortunately, spring runoff of melted snow from the White Mountains area, via the Little Colorado River, is normally sufficient to fill the two nearby reservoirs. More than half the precipitation that falls at Saint Johns in winter falls as snow.

During summer, thundershowers develop somewhere in this area almost every day from the middle of July until the end of August. Many of these storms are of moderate to heavy intensity. Approximately 65 percent of the average annual precipitation at Saint Johns occurs from May to October.

Summer at Saint Johns is relatively mild; temperatures normally range from the middle 50's at night to the high 80's during the day. Temperatures above 100° F. are not common and occur only about once every 2 years. The diurnal variation of temperature is quite large, approaching 40° in May and June when the air is dry and the sky is clear.

Winter in this section is chilly. Although the average temperature in the coldest month is slightly above freezing, readings as low as 22° below zero have been recorded. In general, subzero temperatures can be expected at least once every winter. During the day the temperature usually rises into the upper 40's. Afternoon temperatures of more than 70° may occur on unusually mild midwinter days.

TABLE 8.—*Temperature and precipitation*

Month	Temperature				Precipitation [1]		
	Average daily maximum [2]	Average daily minimum [2]	Two years in 10 will have at least 4 days with [3]—		Average monthly total	One year in 10 will have—	
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—
	°F.	°F.	°F.	°F.	Inches	Inches	Inches
SAINT JOHNS							
January	48	16	62	−1	0.7	0.2	1.3
February	55	21	66	6	.7	.1	1.4
March	60	26	74	14	.8	.1	1.3
April	70	33	82	22	.5	.1	1.1
May	78	40	89	29	.5	0	1.2
June	88	48	97	38	.6	0	1.2
July	90	56	98	50	2.1	.7	3.8
August	88	55	95	49	2.1	.8	3.8
September	83	47	92	37	1.3	0	2.9
October	73	34	83	24	1.0	0	2.5
November	60	23	73	10	.4	0	.9
December	49	16	64	2	.7	.1	1.6
Year	70	35	[4] 99	[5] −6	11.4	7.5	15.2
SPRINGERVILLE							
January	48	15	61	−3	.7	.1	1.6
February	51	19	64	1	.5	0	1.1
March	56	22	68	10	.7	.1	1.4
April	64	30	75	18	.4	0	1.0
May	72	36	83	26	.4	0	1.0
June	81	45	89	34	.4	0	1.1
July	82	51	90	45	2.5	1.1	4.1
August	80	50	88	43	3.1	1.3	5.2
September	77	43	86	34	1.5	.3	3.0
October	69	33	79	21	1.0	0	2.2
November	58	20	68	7	.4	0	1.0
December	50	15	61	−2	.5	0	1.0
Year	66	32	[4] 92	[5] −8	12.1	8.0	16.3
ALPINE							
January	46	10	58	−8	1.6	.4	3.3
February	47	13	59	−6	1.3	.2	2.7
March	51	17	63	1	1.3	.2	2.8
April	59	22	73	13	.7	.1	1.6
May	68	27	78	17	.5	0	1.2
June	77	35	86	26	.8	.1	1.4
July	78	44	87	37	3.1	1.6	4.8
August	77	42	82	35	3.8	2.0	5.9
September	73	34	81	25	2.1	.5	4.2
October	65	27	74	16	1.6	.2	4.1
November	56	16	66	3	.9	0	2.4
December	48	11	62	−4	1.3	.2	2.8
Year	62	25	[4] 88	[5] −17	19.0	9.7	30.0

[1] Period of record 1932–61.

[2] Period of record 1902–57 at Saint Johns, 1912–57 at Springerville, and 1935–57 at Alpine.

[3] Period of record 1932–61 at Saint Johns, July 1948–December 1961 at Springerville, and 1940–61 at Alpine.

[4] Average annual highest temperature.

[5] Average annual lowest temperature.

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall*

SAINT JOHNS
[Based on period of record 1932–61]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in10 later than	April 4	April 13	April 19	May 24	May 30
2 years in 10 later than	March 28	April 7	April 16	May 17	May 24
5 years in 10 later than	March 15	March 27	April 9	May 4	May 12
Fall:					
1 year in 10 earlier than	October 27	October 24	October 17	October 3	September 25
2 years in 10 earlier than	November 1	October 29	October 21	October 8	September 30
5 years in 10 earlier than	November 11	November 5	October 28	October 17	October 8

SPRINGERVILLE
[Based on period of record 1948–61]

Spring:					
1 year in 10 later than	April 19	April 30	May 22	June 3	June 21
2 years in 10 later than	April 14	April 27	May 15	May 29	June 15
5 years in 10 later than	April 5	April 21	May 1	May 21	June 4
Fall:					
1 year in 10 earlier than	October 23	October 15	October 3	September 18	September 13
2 years in 10 earlier than	October 27	October 20	October 8	September 24	September 18
5 years in 10 earlier than	November 4	October 28	October 18	October 6	September 28

ALPINE
[Based on period of record 1932–61]

Spring:					
1 year in 10 later than	May 28	June 13	June 15	June 30	July 10
2 years in 10 later than	May 21	June 6	June 10	June 25	July 4
5 years in 10 later than	May 6	May 24	June 2	June 15	June 24
Fall:					
1 year in 10 earlier than	October 8	September 28	September 13	September 8	August 18
2 years in 10 earlier than	October 14	October 4	September 19	September 12	August 24
5 years in 10 earlier than	October 24	October 14	October 1	September 21	September 3

Transitional zone between steppe and cold temperature climates (Springerville).—Because Springerville is near the mountains, its precipitation is somewhat greater during summer than that of Saint Johns. Wintertime precipitation, however, is somewhat less because the nearby steep slopes of the Mogollon Rim and the White Mountains intercept a large part of the precipitation before it reaches Springerville. As a result of these effects of terrain, about 72 percent of the annual average precipitation falls from May to October. Because of the altitude, nearly all of the precipitation that occurs during December, January, and February and most of that in November and March falls as snow.

Winter temperatures are somewhat lower than those in the steppe area to the north. Temperatures as low as zero have been recorded nearly every year since observations began, and a temperature as low as −10° is recorded about 2 years out of 5. Summer in Springerville has comfortably warm afternoons and cool nights. The average maximum temperatures during the hottest part of summer are in the low 80's. On the average, the temperature reaches 95° or more in only one summer out of ten.

Cold temperature climate (Alpine).—Alpine is in one of the few parts of the state that normally receive enough precipitation to support abundant natural vegetation. Almost half the average annual total of nearly 20 inches usually falls between the first week in July and the middle of September. During this period, afternoon thundershowers form almost daily over the mountains. Although these showers are numerous at Alpine, they are rarely of more than moderate intensity. It is partly as a result of these persistent late-afternoon showers that Alpine has relatively high early morning humidity in midsummer. In some years during the warmer months, moderately heavy

rain showers may persist for two or three days in a row. These are nearly always associated with the remnants of tropical disturbances moving northward from the Pacific Ocean.

Most of the rest of the precipitation at Alpine falls in winter, when middle-latitude storms move eastward from the Pacific Ocean. Despite the fact that some of their moisture is lost on the windward side of the mountains to the west of Alpine, these storms are still capable of giving the area 40 percent of its total annual precipitation during the period of November to April, compared to only 28 percent during the same period at Springerville. Most of this amount falls as snow, usually in gentle to moderate showers that may continue for several days. Snow accumulation may reach a depth of several feet during the colder winters, particularly on northern slopes.

Because of its elevation of 8,000 feet, Alpine has a cool summer climate. In July and August, the warmest months, average temperatures normally vary from the low 40's near daybreak to the middle or upper 70's in the early afternoon. Readings above 90° are extremely rare, being recorded on the average in only 1 year out of every 7. On the other hand, freezing temperatures may occur at night even in the warmest months, although they are also quite rare. Late in spring, early in summer, and in fall the temperature normally varies by more than 40° between day and night.

Winter nights are very cold at Alpine, the minimum temperature averaging close to 10° in December and January. Readings below zero occur regularly in midwinter and have been reported as late as April 2 in spring and as early as October 29 in fall. The lowest temperature on record at Alpine is −29° on the morning of January 30, 1949. Despite the extremely cold nights, the temperature normally rises considerably above freezing during the day, usually reaching the middle 40's by the early afternoon. Even in December and January, the maximum temperature occasionally is more than 60°.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine material dropped by a stream where its gradient lessens abruptly.

Alluvial plain. A plain resulting from the deposition of alluvium by water.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Cinder cone. A conical elevation formed by the accumulation of volcanic ash or clinkerlike material around a vent; also called ash cone (topography).

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Tillage pan. A compacted layer formed in the soil immediately below the plowed layer.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, p. 6.
Estimated yields, table 2, p. 39.

Engineering uses of soils, tables 3, 4, and 5, pp. 46 through 59.

Map symbol	Mapping unit	Page	Capability unit Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Range site Page
BA	Badland	5	------	----	VIIIe-1	38	----------	----
BDB	Bandera gravelly loam, 0 to 8 percent slopes	7	------	----	VIe-1	37	Cinder Upland, 12 to 16 inches precipitation	40
BDE	Bandera gravelly loam, 8 to 60 percent slopes	7	------	----	VIIe-1	38	Cinder Upland, 12 to 16 inches precipitation	40
BEB	Bandera extremely rocky loam, 0 to 8 percent slopes	7	------	----	VIIs-1	38	Cinder Upland, 12 to 16 inches precipitation	40
BsE	Bushvalley cobbly sandy loam, 5 to 40 percent slopes	8	------	----	VIIs-1	38	Shallow Upland, 12 to 16 inches precipitation	43
BuC	Bushvalley loam, 1 to 5 percent slopes	8	------	----	VIs-1	37	Shallow Upland, 12 to 16 inches precipitation	43
CaB	Cambern sandy loam, 1 to 3 percent slopes	8	------	----	IVe-5	36	Loamy Upland, 12 to 16 inches precipitation	42
CaC	Cambern sandy loam, 3 to 5 percent slopes	8	------	----	IVe-5	36	Loamy Upland, 12 to 16 inches precipitation	42
CaD	Cambern sandy loam, 5 to 10 percent slopes	8	------	----	IVe-5	36	Loamy Upland, 12 to 16 inches precipitation	42
CcC	Claysprings clay, 1 to 5 percent slopes	9	------	----	VIe-1	37	Clay Fans, 8 to 12 inches precipitation	40
CDB	Claysprings clay, 0 to 8 percent slopes	9	------	----	VIe-1	37	Clay Fans, 8 to 12 inches precipitation	40
CE	Clover Springs silt loam	9	------	----	VIe-1	37	Loam Bottoms, 16 to 24 inches precipitation	41
CgB	Clover Springs silt loam, 1 to 3 percent slopes	10	------	----	IVe-1	36	Loam Bottoms, 16 to 24 inches precipitation	41
CgC	Clover Springs silt loam, 3 to 5 percent slopes	10	------	----	IVe-1	36	Loam Bottoms, 16 to 24 inches precipitation	41
CgD	Clover Springs silt loam, 5 to 10 percent slopes	10	------	----	IVe-1	36	Loam Bottoms, 16 to 24 inches precipitation	41
CLB	Clovis loamy sand, 0 to 8 percent slopes	11	------	----	VIs-1	37	Loamy Upland, 8 to 12 inches precipitation; Loamy Upland, 12 to 16 inches precipitation	42 42
CmB	Clovis fine sandy loam, 1 to 3 percent slopes	11	IIe-7	35	VIs-1	37	Loamy Upland, 8 to 12 inches precipitation	42
CmC	Clovis fine sandy loam, 3 to 5 percent slopes	11	IIIe-7	35	VIe-1	37	Loamy Upland, 8 to 12 inches precipitation	42

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit Irrigated Symbol	Irrigated Page	Capability unit Dryland Symbol	Dryland Page	Range site Name	Range site Page
CnB	Clovis gravelly fine sandy loam, 1 to 3 percent slopes	11	IIe-7	35	VIs-1	37	Loamy Upland, 8 to 12 inches precipitation	42
CnC	Clovis gravelly fine sandy loam, 3 to 5 percent slopes	11	IIIe-7	35	VIe-1	37	Loamy Upland, 8 to 12 inches precipitation	42
CnE	Clovis gravelly fine sandy loam, 5 to 20 percent slopes	11	------	----	VIe-1	37	Loamy Upland, 8 to 12 inches precipitation	42
CoB	Clovis sandy clay loam, 1 to 3 percent slopes	11	IIe-7	35	VIs-1	37	Loamy Upland, 8 to 12 inches precipitation	42
CoC	Clovis sandy clay loam, 3 to 5 percent slopes	11	IIIe-7	35	VIe-1	37	Loamy Upland, 8 to 12 inches precipitation	42
CsB	Clovis sandy clay loam, thin solum, 1 to 3 percent slopes	11	IIe-7	35	VIs-1	37	Loamy Upland, 8 to 12 inches precipitation	42
CsC	Clovis sandy clay loam, thin solum, 3 to 5 percent slopes	12	IIIe-7	35	VIe-1	37	Loamy Upland, 8 to 12 inches precipitation	42
CTB	Clovis-Palma association, undulating	12						
	Clovis part	----	------	----	VIe-1	37	Loamy Upland, 8 to 12 inches precipitation; Loamy Upland, 12 to 16 inches precipitation	42
	Palma part	----	------	----	VIs-1	37	Sand Upland, 10 to 14 inches precipitation	43
EaB	Eagar loam, 1 to 3 percent slopes	12	IVe-6	36	VIs-1	37	Loam Fans, 10 to 14 inches precipitation	41
EaC	Eagar loam, 3 to 5 percent slopes	13	IVe-6	36	VIe-1	37	Loam Fans, 10 to 14 inches precipitation	41
EaD	Eagar loam, 5 to 10 percent slopes	13	IVe-6	36	VIe-1	37	Loam Fans, 10 to 14 inches precipitation	41
EaE	Eagar loam, 10 to 30 percent slopes	13	------	----	VIe-1	37	Loam Fans, 10 to 14 inches precipitation	41
EgC	Eagar gravelly loam, 0 to 5 percent slopes	13	IVs-6	37	VIs-1	37	Loam Fans, 10 to 14 inches precipitation	41
ER2	Eroded land	13	------	----	VIIe-1	38	Sand Upland, 10 to 14 inches precipitation	43
FRB	Fruitland sandy loam, 1 to 8 percent slopes	14	------	----	VIe-1	37	Loam Fans, 10 to 14 inches precipitation	41
FuC	Fruitland loam, cold variant, 1 to 5 percent slopes	15	IIIe-1	35	VIe-1	37	Loam Fans, 10 to 14 inches precipitation	41
GU	Gullied land	15	------	----	VIIIe-1	38	----------	----
HDB	Hereford loam, 0 to 8 percent slopes	16	------	----	VIe-1	37	Loamy Upland, 12 to 16 inches precipitation	42
HeB	Hereford loam, 1 to 3 percent slopes	16	IIIe-1	35	VIc-1	37	Loamy Upland, 12 to 16 inches precipitation	42
HeC	Hereford loam, 3 to 5 percent slopes	16	IIIe-1	35	VIe-1	37	Loamy Upland, 12 to 16 inches precipitation	42

Map symbol	Mapping unit	Page	Capability unit Irrigated Symbol	Page	Dryland Symbol	Page	Range site Name	Page
HfB	Hereford gravelly loam, 0 to 3 percent slopes	16	IVs-6	37	VIs-1	37	Loamy Upland, 12 to 16 inches precipitation	42
HhB	Hereford loam, heavy variant, 1 to 3 percent slopes	17	IIIe-8	36	VIs-1	37	Loamy Upland, 12 to 16 inches precipitation	42
HrC	Hereford stony loam, heavy variant, 3 to 5 percent slopes	17	------	----	VIs-1	37	Loamy Upland, 12 to 16 inches precipitation	42
HUB	Hubert gravelly loam, 0 to 8 percent slopes	17	------	----	VIs-1	37	Loamy Upland, 12 to 16 inches precipitation	42
HUC2	Hubert gravelly loam, 2 to 15 percent slopes, eroded	17	------	----	VIe-1	37	Loamy Upland, 12 to 16 inches precipitation	42
JoB	Jocity sandy loam, 0 to 3 percent slopes	18	IIe-2	35	VIe-1	37	Loam Fans, 10 to 14 inches precipitation	41
JR	Jocity sandy clay loam	18	------	----	VIe-1	37	Clay Fans, 8 to 12 inches precipitation	40
JS	Jocity-Claysprings complex	18	------	----	VIe-1	37	Clay Fans, 8 to 12 inches precipitation	40
LO	Loamy alluvial land	18	------	----	VIe-1	37	Loam Bottoms, 16 to 24 inches precipitation	41
LuA	Luth clay loam, seeped, 0 to 1 percent slopes	19	IVw-8	37	------	----	Meadow, 12 to 25 inches precipitation	42
LuB	Luth clay loam, seeped, 1 to 3 percent slopes	19	IVw-8	37	------	----	Meadow, 12 to 25 inches precipitation	42
MGD	Millett gravelly sandy loam, 8 to 30 percent slopes	20	------	----	VIe-1	37	Loamy Upland, 8 to 12 inches precipitation; Loamy Upland, 12 to 16 inches precipitation	42 42
MKB	Moenkopie loamy sand, 0 to 8 percent slopes	20	------	----	VIIs-1	38	Shallow Upland, 8 to 12 inches precipitation	43
MOD	Moenkopie very rocky loamy sand, 0 to 30 percent slopes	21	------	----	VIIs-1	38	Shallow Upland, 8 to 12 inches precipitation	43
NaB	Navajo sandy clay loam, 1 to 3 percent slopes	21	IIIe-8	36	VIs-1	37	Clay Bottoms, 10 to 14 inches precipitation	40
NaC	Navajo sandy clay loam, 3 to 5 percent slopes	21	IIIe-8	36	VIe-1	37	Clay Bottoms, 10 to 14 inches precipitation	40
NC	Navajo clay	21	------	----	VIs-1	37	Clay Bottoms, 10 to 14 inches precipitation	40
NdA	Navajo clay, 0 to 1 percent slopes	21	IIIe-3	35	VIs-1	37	Clay Bottoms, 10 to 14 inches precipitation	40
NdB	Navajo clay, 1 to 3 percent slopes	21	IIIe-3	35	VIs-1	37	Clay Bottoms, 10 to 14 inches precipitation	40
NdC	Navajo clay, 3 to 5 percent slopes	21	IIIe-3	35	VIe-1	37	Clay Bottoms, 10 to 14 inches precipitation	40
NlA	Navajo clay, saline-alkali, 0 to 1 percent slopes	22	------	----	VIIs-2	38	Saline Bottoms, 8 to 12 inches precipitation	42

Map symbol	Mapping unit	Page	Capability unit Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Page
NT	Turioso loam	22	------	----	VIc-1	37	Loam Bottoms, 16 to 24 inches precipitation	41
NuA	Nutrioso loam, 0 to 1 percent slopes	22	IIIe-1	35	VIc-1	37	Loam Bottoms, 16 to 24 inches precipitation	41
NuB	Nutrioso loam, 1 to 3 percent slopes	22	IIIe-1	35	VIc-1	37	Loam Bottoms, 16 to 24 inches precipitation	41
NuC	Nutrioso loam, 3 to 5 percent slopes	23	IIIe-1	35	VIe-1	37	Loam Bottoms, 16 to 24 inches precipitation	41
PAB	Palma loamy sand, 0 to 8 percent slopes	23	------	----	VIe-1	37	Sand Upland, 10 to 14 inches precipitation	43
PSB	Palma-Sheppard association, undulating	23	------	----	VIe-1	37	Sand Upland, 10 to 14 inches precipitation	43
RH	Riverwash	24	------	----	VIIIw-1	38	----------	----
RO	Rough broken land	24	------	----	VIIe-1	38	Shallow Upland, 8 to 12 inches precipitation; Shallow Upland, 12 to 16 inches precipitation	43 43
RvB	Rudd loam, 1 to 3 percent slopes	26	------	----	VIs-1	37	Shallow Upland, 12 to 16 inches precipitation	43
RwF	Rudd stony loam, 1 to 45 percent slopes	26	------	----	VIIs-1	38	Shallow Upland, 12 to 16 inches precipitation	43
RXB	Rudd complex, 0 to 8 percent slopes	26	------	----	VIIs-1	38	Shallow Upland, 12 to 16 inches precipitation	43
SA	Sandstone rock land	26	------	----	VIIs-1	38	Shallow Upland, 8 to 12 inches precipitation	43
SD	Sandy alluvial land	26	IIIw-7	36	VIw-2	37	Loam Fans, 10 to 14 inches precipitation	41
Sh	Shay clay	27	VIw-1	37	------	----	Meadow, 12 to 25 inches precipitation	42
SMB	Sheppard loamy sand, 0 to 8 percent slopes	28	------	----	VIIe-1	38	Sand Upland, 10 to 14 inches precipitation	43
Sp	Springerville clay	28	------	----	VIs-1	37	Clay Upland, 16 to 20 inches precipitation	40
SRB	Springerville cobbly clay, 0 to 8 percent slopes	28	------	----	VIs-1	37	Clay Upland, 16 to 20 inches precipitation	40
SU	Stony rock land	28	------	----	VIIs-1	38	Shallow Upland, 12 to 16 inches precipitation	43
TbC	Thunderbird gravelly clay loam, 1 to 5 percent slopes	29	------	----	VIs-1	37	Clay Loam Upland, 16 to 20 inches precipitation	41
TDB	Thunderbird cobbly clay loam, 0 to 15 percent slopes	29	------	----	VIs-1	37	Clay Loam Upland, 16 to 20 inches precipitation	41
TH	Tours sandy loam	30	------	----	VIc-1	37	Loam Fans, 10 to 14 inches precipitation	41
TL	Tours loam	30	------	----	VIc-1	37	Loam Fans, 10 to 14 inches precipitation	41
TmC	Tours sandy clay loam, 3 to 5 percent slopes	30	------	----	VIe-1	37	Loam Fans, 10 to 14 inches precipitation	41

Map symbol	Mapping unit	Page	Capability unit Irrigated Symbol	Irrigated Page	Capability unit Dryland Symbol	Dryland Page	Range site Name	Range site Page
TO	Tours clay loam----------	30	------	----	VIc-1	37	Clay Bottoms, 10 to 14 inches precipitation	40
TrA	Tours clay loam, 0 to 1 percent slopes----------	31	IIc-1	35	VIc-1	37	Clay Bottoms, 10 to 14 inches precipitation	40
TrB	Tours clay loam, 1 to 3 percent slopes----------	31	IIe-1	34	VIc-1	37	Clay Bottoms, 10 to 14 inches precipitation	40
Tu	Tours clay loam, saline alkali-------	31	------	----	VIIs-2	38	Saline Bottoms, 8 to 12 inches precipitation	42
TV	Travertine rock land----------	31	------	----	VIIs-1	38	Shallow Upland, 8 to 12 inches precipitation	43
WFB	Winona fine sandy loam, 0 to 8 percent slopes----------	31	------	----	VIs-1	37	Shallow Upland, 8 to 12 inches precipitation	43
ZeC	Ziegler gravelly loam, 1 to 5 percent slopes----------	32	------	----	IVe-8	36	Clay Loam Upland, 16 to 20 inches precipitation	41
ZGB	Ziegler gravelly clay loam, 0 to 8 percent slopes----------	32	------	----	IVe-8	36	Clay Loam Upland, 16 to 20 inches precipitation	41
ZGE	Ziegler gravelly clay loam, 8 to 60 percent slopes----------	32	------	----	VIIe-1	38	Clay Loam Upland, 16 to 20 inches precipitation	41

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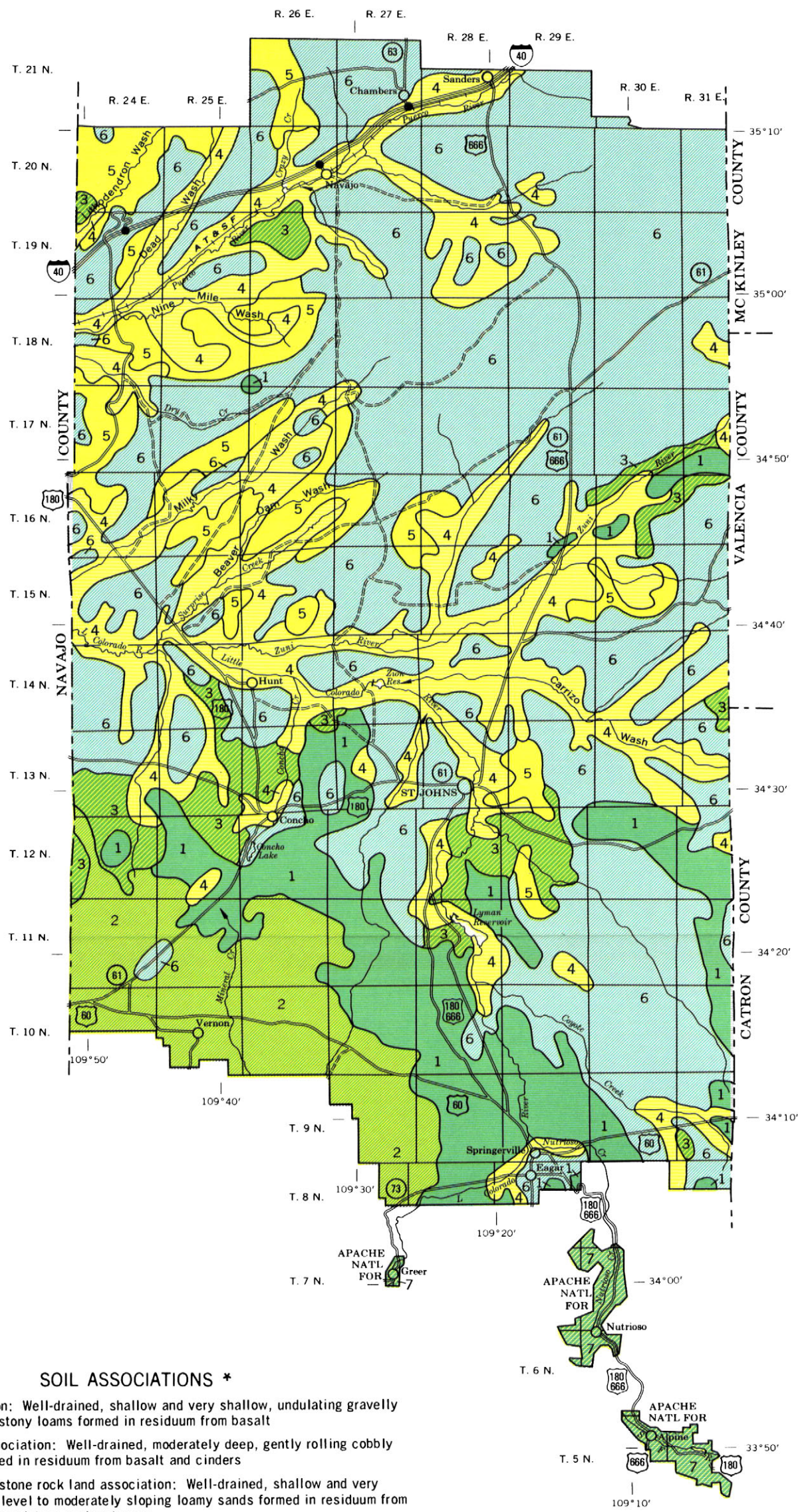


SOIL ASSOCIATIONS *

1. Rudd association: Well-drained, shallow and very shallow, undulating gravelly loams and very stony loams formed in residuum from basalt
2. Thunderbird association: Well-drained, moderately deep, gently rolling cobbly clay loams formed in residuum from basalt and cinders
3. Moenkopie-Sandstone rock land association: Well-drained, shallow and very shallow, nearly level to moderately sloping loamy sands formed in residuum from sandstone, and sandstone rock outcrops
4. Tours-Jocity association: Well-drained, deep, nearly level to gently sloping clay loams and sandy clay loams formed in alluvium
5. Badland-Claysprings association: Barren, eroded land and well-drained, shallow, undulating clays formed in residuum from clayey shales
6. Clovis-Palma-Hubert association: Well-drained, deep, nearly level to undulating loamy sands and gravelly loams formed in eolian sands and alluvium
7. Bushvalley-Cambern association: Well-drained, very shallow to moderately deep, gently sloping to steep sandy loams, cobbly sandy loams, and loams formed in residuum from tuff

* The terms for texture used in the descriptive heading of the associations apply to the surface layer of the major soils.

Compiled 1972

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

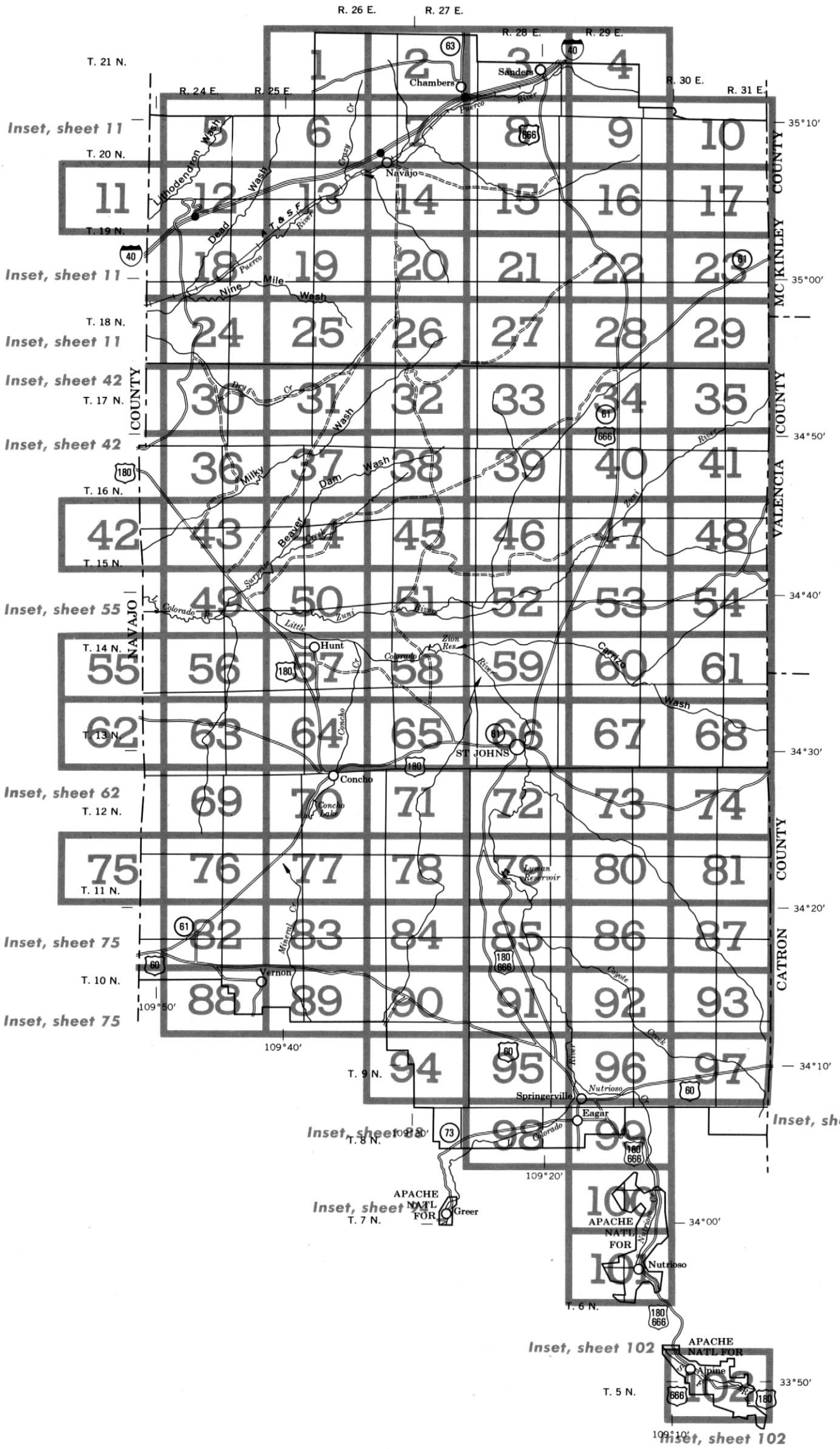
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ARIZONA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

APACHE COUNTY, ARIZONA
CENTRAL PART

Scale 1:570,240

9 0 9 18 Miles



INDEX TO MAP SHEETS

APACHE COUNTY, ARIZONA
CENTRAL PART

Scale 1:570,240

9 0 9 18 Miles

SOIL LEGEND

The first letter, always a capital, is the initial one of the soil name. The second letter is a capital if the mapping unit is one of the low intensity survey; it is a small letter if the mapping unit is one of the high intensity survey. The third letter, always a capital A, B, C, D, E, or F, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for land types that have a considerable range of slope. A final number, 2, in the symbol indicates the soil is eroded.

HIGH INTENSITY SYMBOL	LOW INTENSITY SYMBOL	NAME
–	BA	Badland
–	BDB	Bandera gravelly loam, 0 to 8 percent slopes
–	BDE	Bandera gravelly loam, 8 to 60 percent slopes
–	BEB	Bandera extremely rocky loam, 0 to 8 percent slopes
BsE	–	Bushvalley cobbly sandy loam, 5 to 40 percent slopes
BuC	–	Bushvalley loam, 1 to 5 percent slopes
CaB	–	Cambern sandy loam, 1 to 3 percent slopes
CaC	–	Cambern sandy loam, 3 to 5 percent slopes
CaD	–	Cambern sandy loam, 5 to 10 percent slopes
CcC	–	Claysprings clay, 1 to 5 percent slopes
–	CDB	Claysprings clay, 0 to 8 percent slopes
–	CE	Clover Springs silt loam
CgB	–	Clover Springs silt loam, 1 to 3 percent slopes
CgC	–	Clover Springs silt loam, 3 to 5 percent slopes
CgD	–	Clover Springs silt loam, 5 to 10 percent slopes
–	CLB	Clovis loamy sand, 0 to 8 percent slopes
CmB	–	Clovis fine sandy loam, 1 to 3 percent slopes
CmC	–	Clovis fine sandy loam, 3 to 5 percent slopes
CnB	–	Clovis gravelly fine sandy loam, 1 to 3 percent slopes
CnC	–	Clovis gravelly fine sandy loam, 3 to 5 percent slopes
CnE	–	Clovis gravelly fine sandy loam, 5 to 20 percent slopes
CoB	–	Clovis sandy clay loam, 1 to 3 percent slopes
CoC	–	Clovis sandy clay loam, 3 to 5 percent slopes
CsB	–	Clovis sandy clay loam, thin solum, 1 to 3 percent slopes
CsC	–	Clovis sandy clay loam, thin solum, 3 to 5 percent slopes
–	CTB	Clovis-Palma association, undulating
EaB	–	Eagar loam, 1 to 3 percent slopes
EaC	–	Eagar loam, 3 to 5 percent slopes
EaD	–	Eagar loam, 5 to 10 percent slopes
EaE	–	Eagar loam, 10 to 30 percent slopes
EgC	–	Eagar gravelly loam, 0 to 5 percent slopes
–	ER2	Eroded land
–	FRB	Fruitland sandy loam, 1 to 8 percent slopes
FuC	–	Fruitland loam, cold variant, 1 to 5 percent slopes
–	GU	Gullied land
–	HDB	Hereford loam, 0 to 8 percent slopes
HeB	–	Hereford loam, 1 to 3 percent slopes
HeC	–	Hereford loam, 3 to 5 percent slopes
HeE	–	Hereford loam, 5 to 40 percent slopes
HfB	–	Hereford gravelly loam, 0 to 3 percent slopes
HhB	–	Hereford loam, heavy variant, 1 to 3 percent slopes
HrC	–	Hereford stony loam, heavy variant, 3 to 5 percent slopes
–	HUB	Hubert gravelly loam, 0 to 8 percent slopes
–	HUC2	Hubert gravelly loam, 2 to 15 percent slopes, eroded
JoB	–	Jocity sandy loam, 0 to 3 percent slopes
–	JR	Jocity sandy clay loam
–	JS	Jocity-Claysprings complex
–	LO	Loamy alluvial land
LuA	–	Luth clay loam, seeped, 0 to 1 percent slopes
LuB	–	Luth clay loam, seeped, 1 to 3 percent slopes
–	MGD	Millett gravelly sandy loam, 8 to 30 percent slopes
–	MKB	Moenkopie loamy sand, 0 to 8 percent slopes
–	MOD	Moenkopie very rocky loamy sand, 0 to 30 percent slopes
NaB	–	Navajo sandy clay loam, 1 to 3 percent slopes
NaC	–	Navajo sandy clay loam, 3 to 5 percent slopes
–	NC	Navajo clay
NdA	–	Navajo clay, 0 to 1 percent slopes
NdB	–	Navajo clay, 1 to 3 percent slopes
NdC	–	Navajo clay, 3 to 5 percent slopes
NIA	–	Navajo clay, saline-alkali, 0 to 1 percent slopes
–	NT	Nutrioso loam
NuA	–	Nutrioso loam, 0 to 1 percent slopes
NuB	–	Nutrioso loam, 1 to 3 percent slopes
NuC	–	Nutrioso loam, 3 to 5 percent slopes
–	PAB	Palma loamy sand, 0 to 8 percent slopes
–	PSB	Palma-Sheppard association, undulating
–	RH	Riverwash
–	RO	Rough broken land
RvB	–	Rudd loam, 1 to 3 percent slopes
RwF	–	Rudd stony loam, 1 to 45 percent slopes
–	RXB	Rudd complex, 0 to 8 percent slopes
–	SA	Sandstone rock land
–	SD	Sandy alluvial land
Sh	–	Shay clay
–	SMB	Sheppard loamy sand, 0 to 8 percent slopes
Sp	–	Springerville clay
–	SRB	Springerville cobbly clay, 0 to 8 percent slopes
–	SU	Stony rock land
TbC	–	Thunderbird gravelly clay loam, 1 to 5 percent slopes
–	TDB	Thunderbird cobbly clay loam, 0 to 15 percent slopes
–	TH	Tours sandy loam
–	TL	Tours loam
TmC	–	Tours sandy clay loam, 3 to 5 percent slopes
–	TO	Tours clay loam
TrA	–	Tours clay loam, 0 to 1 percent slopes
TrB	–	Tours clay loam, 1 to 3 percent slopes
Tu	–	Tours clay loam, saline-alkali
–	TV	Travertine rock land
–	WFB	Winona fine sandy loam, 0 to 8 percent slopes
ZeC	–	Ziegler gravelly loam, 1 to 5 percent slopes
–	ZGB	Ziegler gravelly clay loam, 0 to 8 percent slopes
–	ZGE	Ziegler gravelly clay loam, 8 to 60 percent slopes

CENTRAL APACHE COUNTY AREA, ARIZONA

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads

- Divided
- Good motor
- Poor motor
- Trail

Highway markers

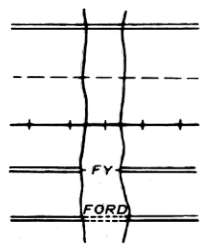
- National Interstate
- U. S.
- State or county

Railroads

- Single track
- Multiple track
- Abandoned

Bridges and crossings

- Road
- Trail
- Railroad
- Ferry
- Ford
- Grade
- R. R. over
- R. R. under



- Buildings
- School
- Church
- Mine and quarry
- Gravel pit
- Power line
- Pipeline
- Cemetery
- Dams
- Levee
- Tanks
- Well, oil or gas
- Sawmill
- Windmill
- **Located object**

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

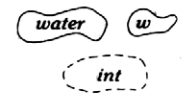
Streams, double-line

- Perennial
- Intermittent

Streams, single-line

- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified
- Canals and ditches

Lakes and ponds



- Perennial
- Intermittent
- Spring
- Wells, artesian, irrigation
- Wet spot
- **Drainage end or alluvial fan**

RELIEF

Escarpments

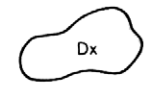
- Bedrock
- Other
- Short steep slope
- Prominent peak

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

- Soil boundary and symbol



- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Saline spot
- Soil sample site

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 1

650 000 FE

1 545 000 FEET

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Land division corners are approximately positioned on this map.

NAVAJO INDIAN RESERVATION BDY
LIMIT OF SOIL SURVEY

FRB ER2 CTB GU CLB BA LO

3 | 2
10 | 11

(Joins sheet 2)

T. 21 N.

1 525 000 FEET

(Joins sheet 6)

680 000 FEET

R. 25 E. | R. 26 E.

1

N

3 Miles 2 1

15 000 Feet 10 000 5 000 0

Scale 1:31 680

1 0 ¼ ½ ¾ 1

5 000 4 000 3 000 2 000 1 000 0

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 2

(2)

N

Scale 1:31 680

3 Miles 2 1 0 1/4 1/2 3/4 1

15000 Feet 10 000 5000 0 1000 2000 3000 4000 5000

710 000 FEET

1 545 000 FEET

1 525 000 FEET

690 000 FEET

R. 26 E. | R. 27 E.

T. 21 N.

NAVAJO INDIAN RESERVATION BDY
LIMIT OF SOIL SURVEY

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 7)

Chambers

CLB CTB ER2 FRB GU PAB RO SD TO

Land division corners are approximately positioned on this map.

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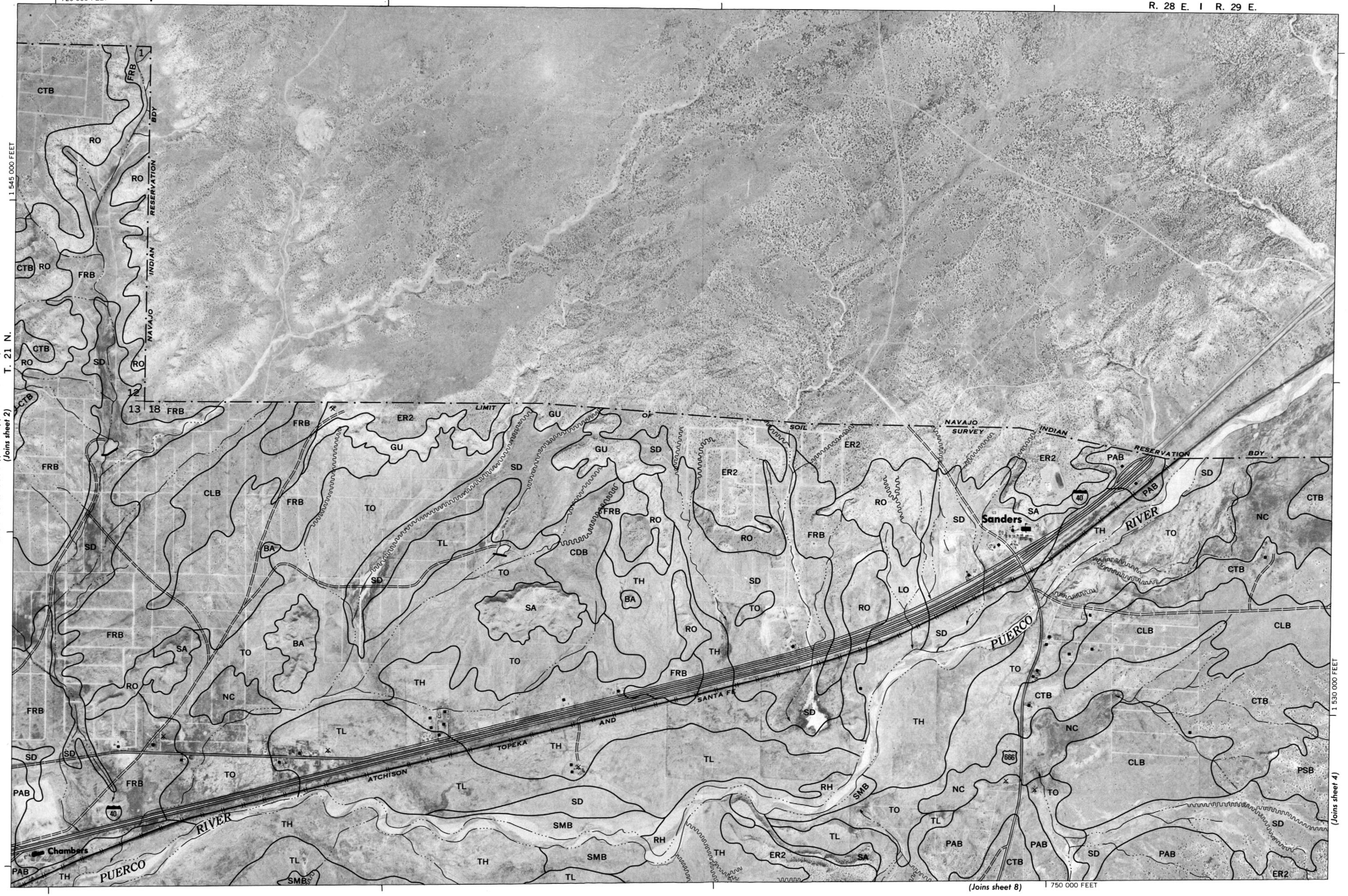
R. 27 E. | R. 28 E.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 3

R. 28 E. | R. 29 E.

(3)



N

Scale 1:31 680

3 Miles
2
1
½
¼
0
15000 Feet
10 000
5000
4000
3000
2000
1000
0

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CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 4

(4)

N

3 Miles

15 000 Feet

10 000

5 000

Scale 1:31 680

T. 21 N.

790 000 FEET

1 550 000 FEET

1 530 000 FEET

760 000 FEET

(Joins sheet 3)

(Joins sheet 9)

R. 29 E.

NAVAJO INDIAN RESERVATION BDY

LIMIT OF NAVAJO SOIL SURVEY

NC

FRB

ER2

LO

CTB

PSB

MINE

int

CLB

SD

SMB

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

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CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 5

610 000 FEET

1 520 000 FEET

T. 20 N.

R. 24 E.

R. 25 E.

1 500 000 FEET

640 000 FEET

5

N

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Land division corners are approximately positioned on this map.

(Joins inset C, sheet 11)

(Joins sheet 6)

(Joins sheet 12)

NAVAJO INDIAN RESERVATION BDY
LIMIT OF SOIL SURVEY

PETRIFIED FOREST NATIONAL PARK

Chinde Mesa

Wash

Lithodendron

13 18
24 19

BA CLB RO JS CTB CDB SA TO

3 Miles
15 000 Feet
10 000
5000
0
1/4 1/2 3/4
1000 2000 3000 4000 5000

Scale 1:31 680

6

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 6

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

(Joins sheet 1)

680 000 FEET

1 520 000 FEET

(Joins sheet 5)

1 500 000 FEET

(Joins sheet 13)

650 000 FEET

(Joins sheet 7)

T. 20 N. | T. 21 N.

R. 25 E. | R. 26 E.

NAVAJO INDIAN RESERVATION BDY
LIMIT OF SOIL SURVEY

PETRIFIED FOREST NATIONAL PARK

Dead Wash

Crazy Creek

WATER

31 | 1 6

9 10 | 16 15

40

BA CDB CLB CTB ER2 FRB GU JS LO PAB RO TO

Land division corners are approximately positioned on this map.

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CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 7

690 000 FEET

(Joins sheet 2)

1 520 000 FEET

T. 20 N. | T. 21 N.

(Joins sheet 6)

(Joins sheet 8)

R. 26 E. | R. 27 E.

(Joins sheet 14)

720 000 FEET

1 500 000 FEET

7

N

Chambers

Navajo

RIVER

PUERCO

Airstrip

SANTA FE AND TOPEKA ATCHISON

WATER

GU BA CLB CDB ER2 RO LO CTB FRB TO RH TL PAB SA SD SMB TH MOD

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

Scale 1:31 680

1 5000 4000 3000 2000 1000 0

¾ ½ ¼ 0

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Land division corners are approximately positioned on this map.

8

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 8

R. 27 E. | R. 28 E. (Joins sheet 3)

R. 28 E. | R. 29 E.

750 000 FEET

1 520 000 FEET

T. 20 N. | T. 21 N.

1 500 000 FEET

720 000 FEET

(Joins sheet 7)

(Joins sheet 9)

(Joins sheet 15)

N

3 Miles 2 1

15 000 Feet 10 000 5 000

Scale 1:31 680

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

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CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 9

760 000 FEET

1 520 000 FEET

T. 20 N. | T. 21 N.

33 | 34
4 | 3

(Joins sheet 4)

(Joins sheet 8)

(Joins sheet 10)

R. 29 E. | R. 30 E.

790 000 FEET

(Joins sheet 16)

NAVAJO INDIAN RESERVATION BDY
LIMIT OF SOIL SURVEY

Micro-Wave Telephone A T And T

SD
PSB
ER2
CTB
SMB
CLB
LO
GU
FRB
BA
Int

N

9

3 Miles 2 1

15000 Feet 10 000 5000

Scale 1:31 680

1 ½ 0 1 ¼ 0 1 ½ 1 ¾ 1

5000 4000 3000 2000 1000 0

1 500 000 FEET

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Land division corners are approximately positioned on this map.

(10)

N

3 Miles 15 000 Feet

2 10 000

1 5 000

Scale 1:31 680

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

5 000

830 000 FEET

1 520 000 FEET

T. 20 N. | T. 21 N.

(Joins sheet 9)

LIMIT OF SOIL SURVEY NAVAJO INDIAN RESERVATION BDY

int

SMB LO FRB CTB ER2 GU BA PAB PSB

MCKINLEY COUNTY NEW MEXICO

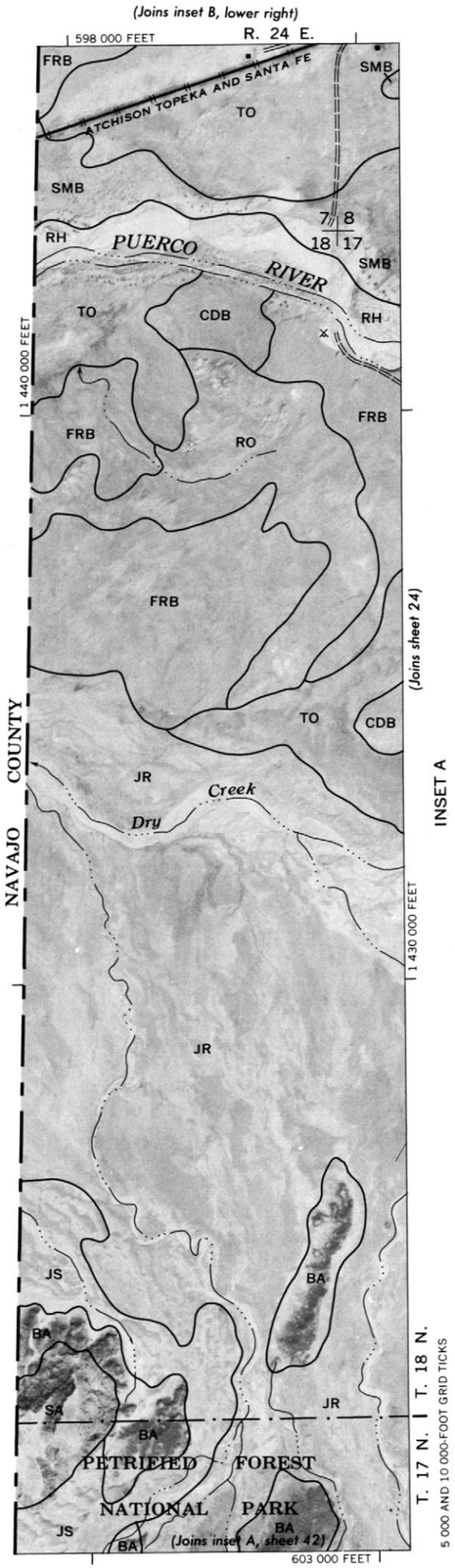
1 500 000 FEET

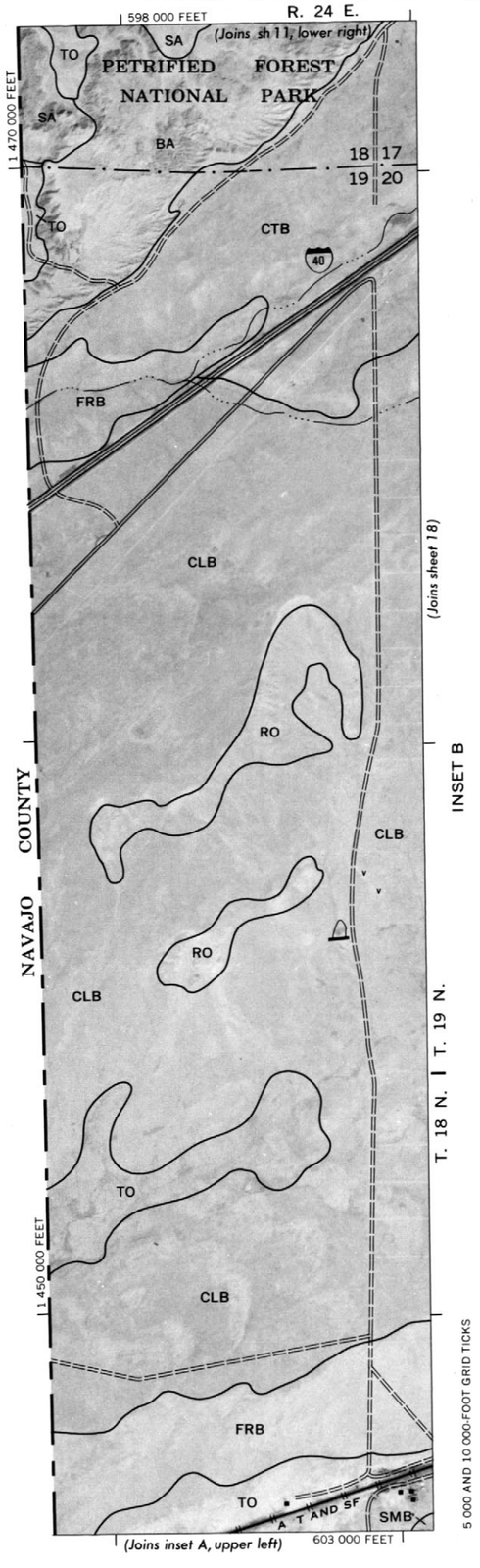
800 000 FEET

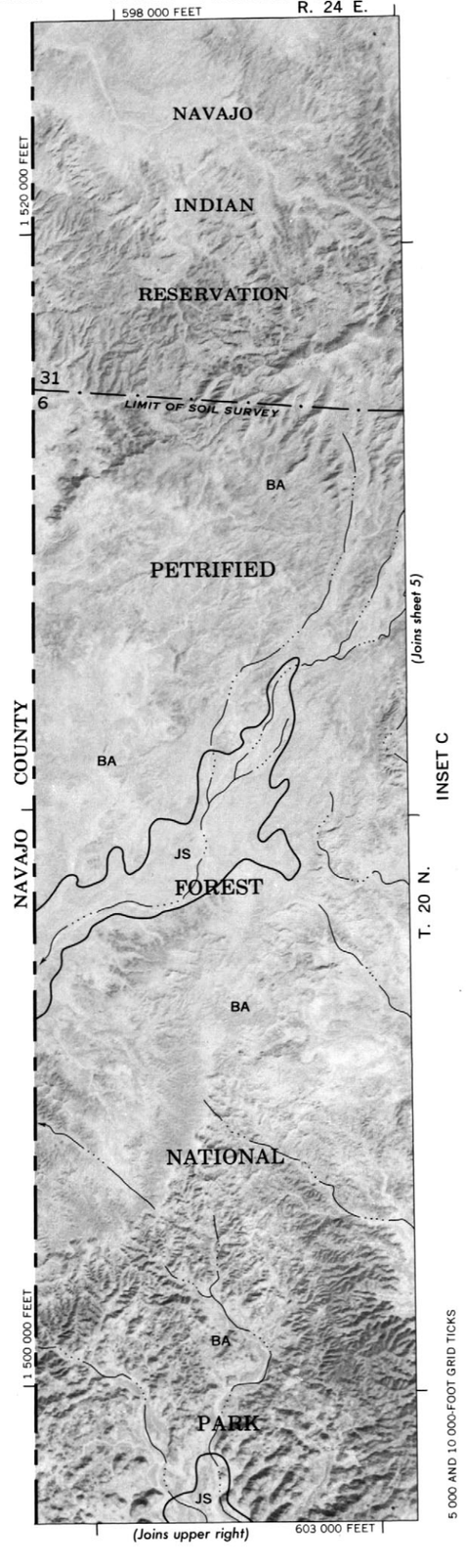
(Joins sheet 17)

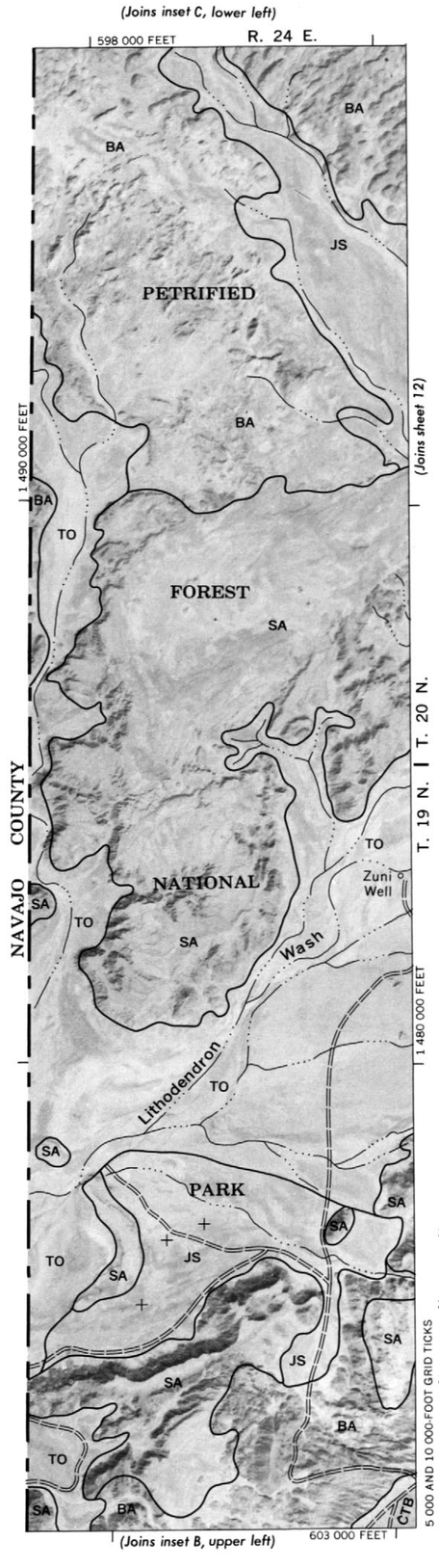
R. 30 E. | R. 31 E.

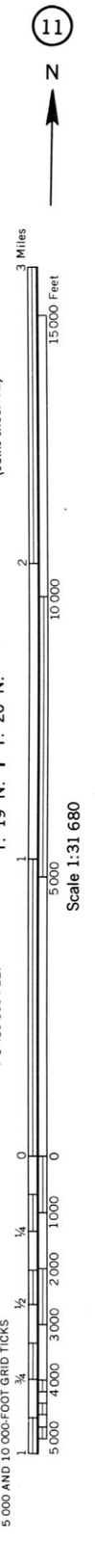
CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 11











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5 000 AND 10 000-FOOT GRID TICKS

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 12

(Joins sheet 5)

(Joins sheet 11)

(Joins sheet 18)

(Joins sheet 13)

640 000 FEET

610 000 FEET

1 490 000 FEET

1 480 000 FEET

R. 24 E.

R. 25 E.

T. 19 N.

T. 20 N.

N

Scale 1:31 680

3 Miles 2 1

15 000 Feet 10 000 5 000 0

1 ½ 0

¼ 0

5 000 4000 3000 2000 1000 0

PETRIFIED FOREST NATIONAL PARK

Lithodendron Wash

Painted Desert Inn

Zuni Well

Petrified Forest National Park Headquarters

Dead Wash

35 36 2 1

36 31 1 6

BA JS CDB CTB RO TO SA SU ER2 PSB TL SMB MOD PAB NC TH

Land division corners are approximately positioned on this map.

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CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 13

13

N

650 000 FEET

(Joins sheet 6)

1 490 000 FEET

T. 19 N.

(Joins sheet 12)

1 480 000 FEET

(Joins sheet 14)

R. 25 E. | R. 26 E.

(Joins sheet 19)

680 000 FEET

Wash
Dead
Creek
Crazy
Point
PUERCO RIVER
SANTA FE
AND
TOPEKA
ATCHISON
PUERCO
RIVER
Pinta
Gas

25 30
36 31

CTB CDB CLB FRB LO PAB RO RH SA SMB TH TL TO NC MOD MKB JS BA

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Land division corners are approximately positioned on this map.

3 Miles
2
1
15 000 Feet
10 000
5 000
0
5 000 4 000 3 000 2 000 1 000 0
¾ ½ ¼ 0

Scale 1:31 680

(14)

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 14

(Joins sheet 7)

R. 26 E. | R. 27 E.

720 000 FEET

N

3 Miles

15 000 Feet

2

10 000

1

5 000

Scale 1:31 680

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

5000

(Joins sheet 13)

1 480 000 FEET

1 490 000 FEET

T. 20 N. | T. 19 N.

(Joins sheet 15)

(Joins sheet 20)

690 000 FEET

PUERCO RIVER

ATCHISON AND SANTA FE

WATER

Navajo Springs

25 30 36 31

Gas

TO FRB PAB LO NC MOD MKB CLB CDB TH RH CTB RO ER2 PSB SD SMB GU BA

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

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CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 15

15

N

720 000 FEET

R. 27 E. | R. 28 E.

(Joins sheet 8)

R. 28 E. | R. 29 E.

1 490 000 FEET

T. 19 N. | T. 20 N.

1 480 000 FEET

750 000 FEET

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 21)

25 30
36 31

5 4
8 9

9 10
16 15

FRB SD LO PAB CTB ER2 CLB PSB SMB GU BA

int — intermittent — WATER

666

3 Miles 2 1 0 15000 Feet 10000 5000

Scale 1:31 680

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Land division corners are approximately positioned on this map.

(Joins sheet 9)

R. 29 E. | R. 30 E.

790 000 FEET

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

1 480 000 FEET

1 490 000 FEET

T. 19 N. | T. 20 N.

(Joins sheet 15)

(Joins sheet 17)

(Joins sheet 22)

760 000 FEET

33 | 34
4 | 3

36 | 31
1 | 6

CLB PSB BA CTB ER2 FRB LO PAB SMB GU SD

666

int

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

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CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 17

(Joins sheet 10)

800 000 FEET

R. 30 E. | R. 31 E.

N

1 490 000 FEET

T. 20 N. | T. 19 N.

(Joins sheet 16)

1 480 000 FEET

(Joins sheet 23)

830 000 FEET

3 Miles
2
15000 Feet
10 000
5000
1
0
1000
2000
3000
4000
5000
Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 18

N

Scale 1:31 680

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

¼ ½ ¾ 1

1000 2000 3000 4000 5000

(Joins sheet 12)

(Joins inset B, sheet 11)

(Joins sheet 19)

(Joins sheet 24)

BA

1 470 000 FEET

1 450 000 FEET

610 000 FEET

640 000 FEET

T. 18 N. | T. 19 N.

R. 24 E. | R. 25 E.

PETRIFIED FOREST NATIONAL PARK

PUERCO RIVER

Dead Wash

Nine Mile Wash

SANTA FE AND TOPEKA ATCHISON

Adamana

36 31 32 1 6 5 33 34 4 3

CTB CLB CDB BA RO SMB PSB SA TO ER2 TL TH NC RH FRB JR SD JS PAB

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 19

650 000 FEET

1 470 000 FEET

(Joins sheet 13)

(Joins sheet 18)

(Joins sheet 20)

(Joins sheet 25)

1 450 000 FEET

680 000 FEET

T. 18 N. | T. 19 N.

R. 25 E. | R. 26 E.

PUERCO RIVER

Nine Mile Wash

WATER

N

Scale 1:31 680

3 Miles 2 1 0 1

15 000 Feet 10 000 5 000 0 5 000

1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

20

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 20

(Joins sheet 14)

R. 26 E. | R. 27 E.

720 000 FEET

1 470 000 FEET

(Joins sheet 21)

T. 18 N. | T. 19 N.

(Joins sheet 19)

1 450 000 FEET

690 000 FEET

(Joins sheet 26)

N

3 Miles 2 1 0

15000 Feet 10 000 5000 0

Scale 1:31 680

1 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 21

CENTRAL APACHE COUNTY AREA, ARIZONA NO. 21

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

T. 18 N. | T. 19 N.

720 000 FEET | R. 27 E. | R. 28 E. | (Joins sheet 15) | R. 28 E. | R. 29 E.

1 470 000 FEET

1 450 000 FEET

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 27)

750 000 FEET

21

N

Scale 1:31 680

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

22

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 22

N

Scale 1:31 680

3 Miles 2 1 0 5000 10 000 15 000 Feet

1 5000 ¾ 4000 ½ 3000 ¼ 2000 0 1000 0 5000 Feet

(Joins sheet 16)

(Joins sheet 21)

(Joins sheet 23)

(Joins sheet 28)

R. 29 E. | R. 30 E.

T. 18 N. | T. 19 N.

790 000 FEET

1 470 000 FEET

1 450 000 FEET

760 000 FEET

19 20 30 29

666

WATER

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA NO. 22

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 23

23

N

800 000 FEET

R. 30 E. | R. 31 E.

(Joins sheet 17)

1 470 000 FEET

T. 18 N. | T. 19 N.

(Joins sheet 22)

(Joins sheet 29)

830 000 FEET

1 450 000 FEET

NEW MEXICO

MC KINLEY COUNTY

CTB ER2 CLB PSB PAB GU LO int WATER intermittent 61

3 Miles 15 000 Feet 10 000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000 0 1000 2000 3000 4000 5000

(Joins sheet 18)

640 000 FEET

1 440 000 FEET

1 430 000 FEET

610 000 FEET

(Joins inset A, sheet 11)

(Joins sheet 25)

(Joins sheet 30)

T. 17 N. | T. 18 N.

R. 25 E. | R. 24 E.

Adamana

Newspaper Rock

The Teepees

Blue Forest

The Haystacks

Black Knoll

Nine Mile Wash

PUERCO RIVER

Dry Creek

PETRIFIED FOREST NATIONAL PARK

TO SMB RH SD SA CTB JR CDB NC JS FRB RO MKB BA SU PSB CLB TH

12 7 13 18

24 19 25 30

32 33 5 4

36 31 1 6

31 32 6 5

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 25

R. 25 E. | R. 26 E.

650 000 FEET

(Joins sheet 19)

25

N

Nine Mile Wash

1 440 000 FEET

1 430 000 FEET

T. 17 N. | T. 18 N.

35 | 36
2 | 1

31 | 32
6 | 5

(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 31)

680 000 FEET

Black Knoll

JS BA TO RO CDB JR MOD SA TL PSB SMB CTB CLB SU

WATER

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

3 Miles
2
1
0
15 000 Feet
10 000
5000

¼ 0 ¼ ½ ¾ 1
1000 2000 3000 4000 5000

Scale 1:31 680

(Joins sheet 20)

R. 26 E. | R. 27 E.

720 000 FEET

1 440 000 FEET

1 430 000 FEET

690 000 FEET

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 32)

N

3 Miles 2 1 0 15 000 Feet 10 000 5 000

Scale 1:31 680

¼ 0 1000 2000

½ 3000

¾ 4000

1 5000

T. 17 N. | T. 18 N.

10 | 11
15 | 14

15 | 14
22 | 23

30 | 29
31 | 32

26 | 25
35 | 36

PAB BA GU PSB SMB CTB ER2 JS CLB SD WATER

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 27

(27)

N

R. 27 E. | R. 28 E. — (Joins sheet 21) — R. 28 E. | R. 29 E.

720 000 FEET

1 440 000 FEET

1 430 000 FEET

750 000 FEET

T. 18 N.

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 33)

12 | 7
13 | 18

16 | 15
21 | 22

30 | 29
31 | 32

36 | 31
1 | 6

CTB CLB PSB ER2 GU PAB int

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

3 Miles
2
1
15 000 Feet
10 000
5 000
0
5 000 4 000 3 000 2 000 1 000 0
¾ ½ ¼ 0

Scale 1:31 680

28

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 28

R. 29 E. | R. 30 E.

790 000 FEET

(Joins sheet 22)

(Joins sheet 27)

1 440 000 FEET

1 430 000 FEET

760 000 FEET

(Joins sheet 34)

(Joins sheet 29)

T. 18 N.

N

Scale 1:31 680

3 Miles 2 1 0 15000 Feet 10 000 5000 0

¼ ½ ¾ 1000 2000 3000 4000 5000

PSB CTB ER2 CLB LO GU

int intermittent

666 61

28 | 27
33 | 34

26 | 25
35 | 36

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 29

29

N

R. 30 E. | R. 31 E.

800 000 FEET

1 440 000 FEET

1 430 000 FEET

830 000 FEET

T. 18 N.

(Joins sheet 23)

(Joins sheet 28)

(Joins sheet 35)

F A A Radio
Zuni Omni

intermittent

int

NEW MEXICO — MC KINLEY COUNTY — NEW MEXICO

VALENCIA COUNTY

CTB CLB ER2 GU LO PSB SMB

3 Miles 2 1 0 15000 Feet 10 000 5000

Scale 1:31 680

1 ½ 0 5000

¾ ¼ 0 4000 3000 2000 1000 0

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

(Joins sheet 24)

640 000 FEET

1 420 000 FEET

N

3 Miles

15000 Feet

10 000

5000

Scale 1:31 680

(Joins inset A, sheet 42)

1 400 000 FEET

Agate Bridge

The Battleship

The Flat Tops

Dry Creek

Wallace Tank

Dry Creek

P E T R I F I E D F O R E S T

N A T I O N A L P A R K

P U E R C O R I D G E

28 27
33 34

T. 17 N.

(Joins sheet 31)

(Joins sheet 36)

610 000 FEET

R. 24 E.

R. 25 E.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 31

31

N

650 000 FEET

(Joins sheet 25)

1 420 000 FEET

(Joins sheet 30)

(Joins sheet 32)

1 400 000 FEET

680 000 FEET

(Joins sheet 37)

T. 17 N.

R. 25 E. | R. 26 E.

PUERCO RIDGE

WATER

Dry Creek

Draw

Place

Potters

I-40

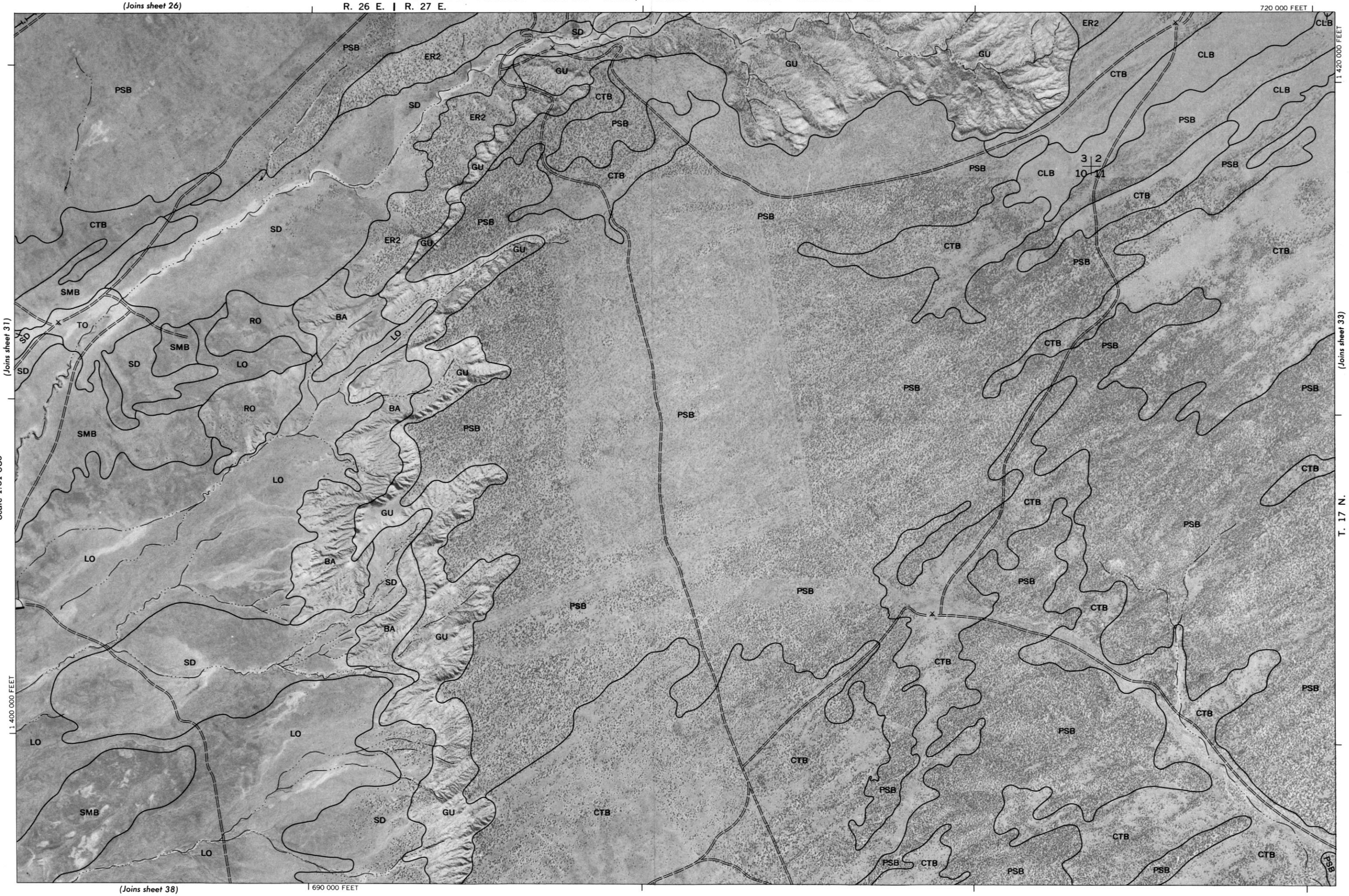
CLB CTB CDB PSB JS FRB LO TO BA RO SD SMB

30 29

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

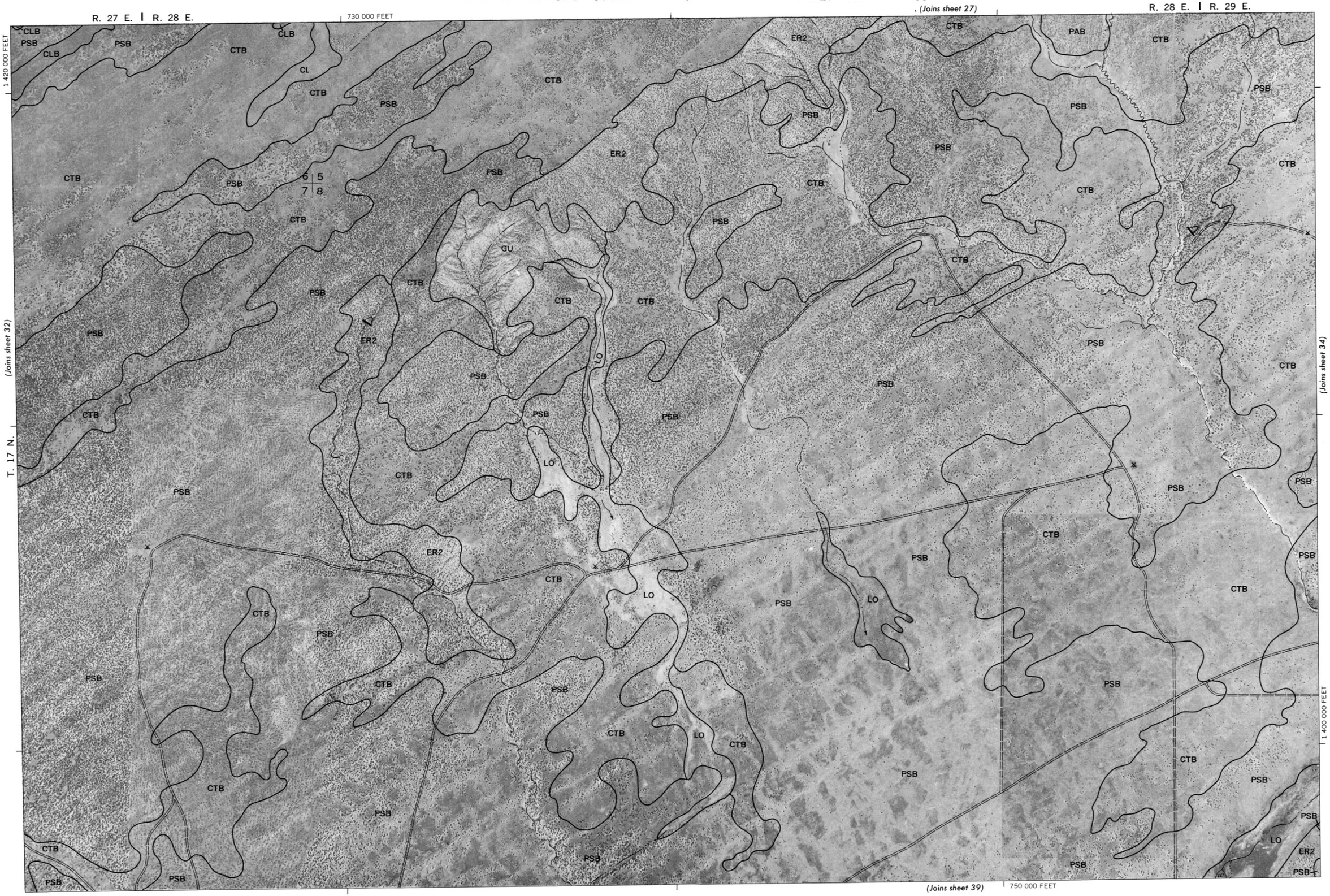
3 Miles
2
15 000 Feet
10 000
5000
1
0
5000
¾
4000
½
3000
¼
2000
1000
0

Scale 1:31 680



Land division corners are approximately positioned on this map.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 33



33

N

3 Miles 2 1 0 15000 Feet 10 000 5000

Scale 1:31 680

1 ¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

34

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 34

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

(Joins sheet 28)

R. 29 E. | R. 30 E.

790 000 FEET

1 420 000 FEET

(Joins sheet 33)

(Joins sheet 35)

T. 17 N.

1 400 000 FEET

760 000 FEET

(Joins sheet 40)

6 5
7 8

19 20
30 29

CTB PSB CLB ER2 LO SMB

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

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CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 35

35

N

800 000 FEET

1 420 000 FEET

(Joins sheet 29)

(Joins sheet 34)

T. 17 N.

PSB ER2 CTB SMB

3 2
10 11

6 5
7 8

NEW MEXICO

VALENCIA COUNTY

PAB TO CLB SA GU SU

Zuni River

1 400 000 FEET

(Joins sheet 41)

1 830 000 FEET

R. 30 E. R. 31 E.

3 Miles 2 1 0 15 000 Feet 10 000 5 000 0

Scale 1:31 680

5 000 4 000 3 000 2 000 1 000 0

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Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000 0 5 000 4 000 3 000 2 000 1 000 0

(Joins sheet 30)

(Joins inset B, sheet 42)

(Joins sheet 43)

(Joins sheet 37)

640 000 FEET

610 000 FEET

1 390 000 FEET

1 370 000 FEET

T. 16 N. | T. 17 N.

R. 24 E. | R. 25 E.

PETRIFIED FOREST NATIONAL PARK

RIDGE

Wash

Cow Wash

Wild Cow

Milky Wash

UNDERGROUND CABLE

180

36 31

8 9 17 16

9 10 16 15

BA CLB CTB CDB FRB JR JS PSB RO SA SMB

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 37

37

N

650 000 FEET

(Joins sheet 31)

T. 16 N. | T. 17 N.

1 390 000 FEET

(Joins sheet 36)

(Joins sheet 38)

1 370 000 FEET

680 000 FEET

(Joins sheet 44)

R. 25 E. | R. 26 E.

30 | 29
31 | 32

36 | 31

Wash

Milky

Wash

Dam

Beaver

SMB

CTB

CLB

BA

JS

RO

LO

TO

JR

CDB

PSB

SD

3 Miles

15 000 Feet

10 000

Scale 1:31 680

5000

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

(Joins sheet 32)

720 000 FEET

1 390 000 FEET

T. 16 N. | T. 17 N.

N

3 Miles

15 000 Feet

2

10 000

1

5 000

Scale 1:31 680

0 0

¼ 1000

½ 2000 3000

¾ 4000 5000

1 5000 FEET

(Joins sheet 37)

(Joins sheet 39)

(Joins sheet 45)

690 000 FEET

R. 27 E. | R. 26 E.

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

SMB LO GU SD CTB PSB ER2 TO JS BA RO FRB CLB

Beaver Dam Wash

Surprise Creek

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 39

39

N

R. 27 E. | R. 28 E. | 730 000 FEET | (Joins sheet 33) | R. 28 E. | R. 29 E.

T. 16 N. | T. 17 N.

1 390 000 FEET

1 380 000 FEET

(Joins sheet 38)

(Joins sheet 40)

(Joins sheet 46)

760 000 FEET

CTB PSB RO TO ER2 LO TL FRB CLB BA

3 Miles 2 1 0 15 000 Feet 10 000 5 000

¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 40

N

Scale 1:31 680

3 Miles 2 1 0 15000 Feet 10 000 5000

1 5000 ¼ 1000 ½ 2000 ¾ 4000 1 5000

(Joins sheet 34)

R. 29 E. | R. 30 E.

790 000 FEET

1 390 000 FEET

T. 16 N. | T. 17 N.

1 380 000 FEET

760 000 FEET

(Joins sheet 39)

(Joins sheet 41)

(Joins sheet 47)

31 32
6 5

PSB SMB CTB ER2 GU LO CLB BA RO SA TO PAB SU

81 666 61 666

Zuni River

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 41

41

N

800 000 FEET

(Joins sheet 35)

T. 16 N.

T. 17 N.

1 390 000 FEET

Zuni River

NEW MEXICO

VALENCIA COUNTY

1 380 000 FEET

(Joins sheet 40)

(Joins sheet 48)

830 000 FEET

R. 30 E.

R. 31 E.

PSB CTB GU SA TO PAB ER2 RXB SU CLB LO

3 Miles

15 000 Feet

10 000

5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum. Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 42

42

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

¼ 0 1 000 2 000 3 000 4 000 5 000

½ 0 ¾ 1

R. 24 E. 603 000 FEET

(Joins inset A, sheet 11)

1 420 000 FEET

COUNTY

NAVAJO

T. 17 N.

INSET A

(Joins sheet 30)

1 400 000 FEET

19

30

(Joins inset B, upper right)

598 000 FEET

5 000 AND 10 000-FOOT GRID TICKS

R. 24 E. 600 000 FEET

(Joins inset A, lower left)

NAVAJO COUNTY

P E T R I F I E D

F O R E S T

N A T I O N A L

P A R K

180

UNDERGROUND CABLE

1 390 000 FEET

T. 16 N. | T. 17 N.

INSET B

(Joins sheet 36)

1 370 000 FEET

595 000 FEET

(Joins upper right)

(Joins inset B, lower left) R. 24 E. 601 000 FEET

NAVAJO COUNTY

31

6

Wash

Milky

1 360 000 FEET

T. 15 N. | T. 16 N.

(Joins sheet 43)

1 350 000 FEET

596 000 FEET

(Joins inset A, sheet 55 upper left)

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 43

43

N

610 000 FEET

R. 24 E. | R. 25 E.

(Joins sheet 36)

1 360 000 FEET

T. 15 N. | T. 16 N.

1 350 000 FEET

(Joins sheet 44)

(Joins sheet 42)

(Joins sheet 49)

640 000 FEET

Milky Wash

UNDERGROUND

CABLE

POTTER

MESA

33 | 34
4 | 3

31 | 32
6 | 5

CDB PSB CTB FRB JR SMB RO NC TO BA JS CLB ER2

180

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

3 Miles
2
1
0
15 000 Feet
10 000
5 000
0

Scale 1:31 680

1 | 0 | 1/4 | 1/2 | 3/4 | 1
5000 | 4000 | 3000 | 2000 | 1000 | 0

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 44

(Joins sheet 37)

680 000 FEET

1 370 000 FEET

T. 15 N. | T. 16 N.

(Joins sheet 45)

(Joins sheet 43)

1 350 000 FEET

(Joins sheet 50)

650 000 FEET

R. 25 E. | R. 26 E.

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

¼ 0 1000 ½ 2000 ¾ 3000 1 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NO. 44

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 45

R. 26 E. | R. 27 E.

690 000 FEET

1 370 000 FEET

T. 15 N. | T. 16 N.

(Joins sheet 38)

(Joins sheet 44)

(Joins sheet 46)

(Joins sheet 51)

1 350 000 FEET

720 000 FEET

45

N

Surprise Creek

JS JR RO CTB CLB FRB BA TL PSB CDB TO GU ER2 SU

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

3 Miles 2 1 0 15 000 Feet 10 000 5000

1 ¼ ½ ¾ 0 1000 2000 3000 4000 5000

Scale 1:31 680

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 46

46

N

R. 27 E. | R. 28 E.

(Joins sheet 39)

R. 28 E. | R. 29 E.

760 000 FEET

1 370 000 FEET

T. 15 N. | T. 16 N.

(Joins sheet 45)

(Joins sheet 47)

1 350 000 FEET

730 000 FEET

(Joins sheet 52)

3 Miles

15 000 Feet

10 000

5 000

Scale 1:31 680

CTB BA ER2 RO TO FRB CLB NC CDB PSB CtB SU GU

36 31
1 6

17 16
20 21

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 47

47

N

760 000 FEET

R. 29 E. | R. 30 E.

(Joins sheet 40)

1 370 000 FEET

T. 15 N. | T. 16 N.

(Joins sheet 46)

(Joins sheet 48)

1 350 000 FEET

790 000 FEET

(Joins sheet 53)

Zuni River

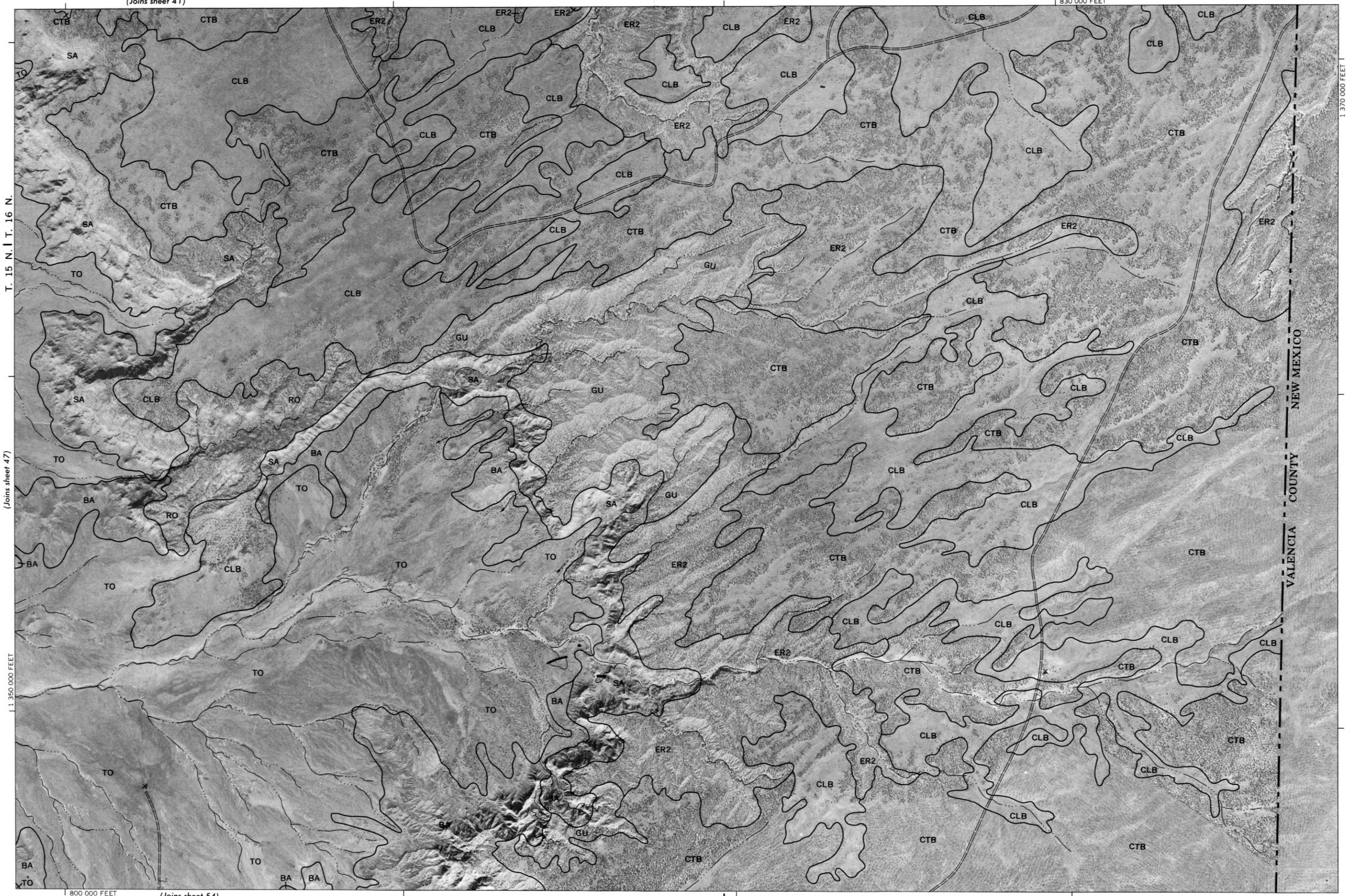
Zuni River

CTB ER2 RO GU TO CLB SU FRB NC SA BA

3 Miles 2 1 0 15 000 Feet 10 000 5 000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.



N

3 Miles

15000 Feet

10 000

Scale 1:31 680

(Joins sheet 47)

5000

4000

3000

2000

1000

0

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone: 1927 North American datum.

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CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 49

R. 24 E. | R. 25 E.

610 000 FEET

1 340 000 FEET

T. 14 N. | T. 15 N.

1 320 000 FEET

640 000 FEET

(Joins inset A, sheet 55)

(Joins sheet 43)

(Joins sheet 50)

(Joins sheet 56)

49

N

Scale 1:31 680

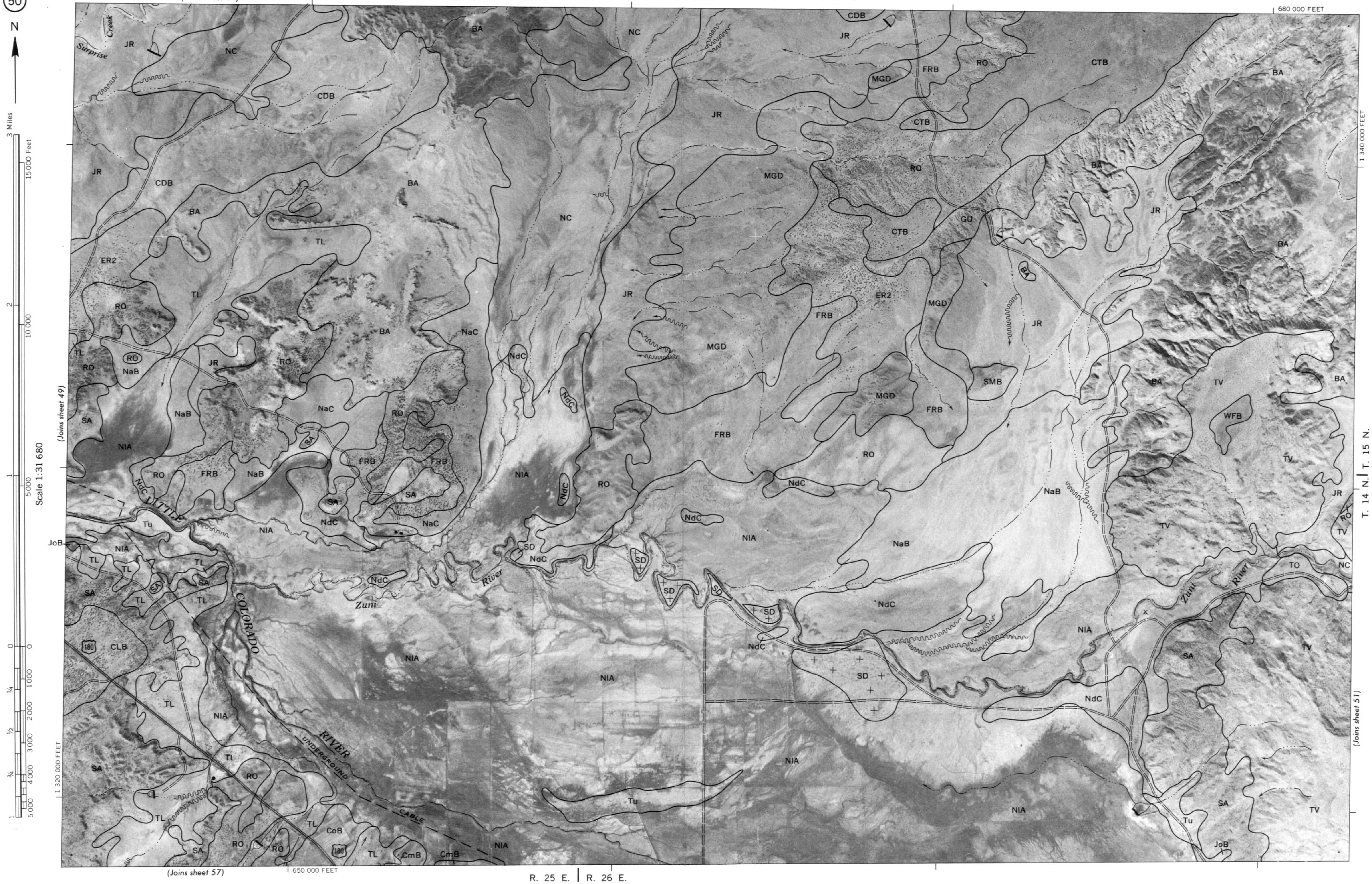
3 Miles 2 0 15 000 Feet 10 000

1 ¼ ½ ¾ 1 0 1000 2000 3000 4000 5000 5000

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

MESA
POTTER
UNDERGROUND CABLE
Surprise Creek
LITTLE COLORADO RIVER

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 50



CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 51

690 000 FEET

(Joins sheet 45)

51

N

1 340 000 FEET

T. 15 N.

T. 14 N.

(Joins sheet 50)

(Joins sheet 52)

1 320 000 FEET

R. 26 E. | R. 27 E.

(Joins sheet 58)

720 000 FEET

3 Miles 2 1 0 1

15 000 Feet 10 000 5 000 0 1000 2000 3000 4000 5000

Scale 1:31 680

Zuni River

9 | 10
16 | 15

11 | 12
14 | 13

52

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 52

R. 27 E. | R. 28 E. (Joins sheet 46)

R. 28 E. | R. 29 E.

760 000 FEET

1 340 000 FEET

T. 15 N.

T. 14 N.

(Joins sheet 53)

(Joins sheet 51)

1 320 000 FEET

730 000 FEET

(Joins sheet 59)

N

Scale 1:31 680

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

1 5 000 ¼ 1000 ½ 2000 3000 ¾ 4000 5000

24 | 19
25 | 30

35 | 36
2 | 1

Zuni River

Zuni River

SU CTB NC TO ER2 CLB FRB JR SA BA RO TH CDB

666 61

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NO. 52

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 53

53

760 000 FEET

(Joins sheet 47)

R. 29 E. | R. 30 E.

1 340 000 FEET

T. 15 N. | T. 14 N.

(Joins sheet 52)

(Joins sheet 54)

1 320 000 FEET

790 000 FEET

(Joins sheet 60)

Zuni River

61 666

33 34 4 3

36 31 1 6

N

3 Miles 2 1 0

15 000 Feet 10 000 5 000

Scale 1:31 680

¼ ½ ¾ 1

1000 2000 3000 4000 5000

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 54

54

N

(Joins sheet 48)

830 000 FEET

1 340 000 FEET

(Joinssheet 53)

T. 14 N. | T. 15 N.

3 Miles

15000 Feet

2

10 000

Scale 1:31 680

1

5 000

0 0

¼ 1000

½ 2000

¾ 3000

4000

5000

1 320 000 FEET

800 000 FEET

(Joins sheet 61)

R. 30 E. | R. 31 E.

23 30
36 31

NEW MEXICO

VALENCIA COUNTY

Land division corners are approximately positioned on this map.

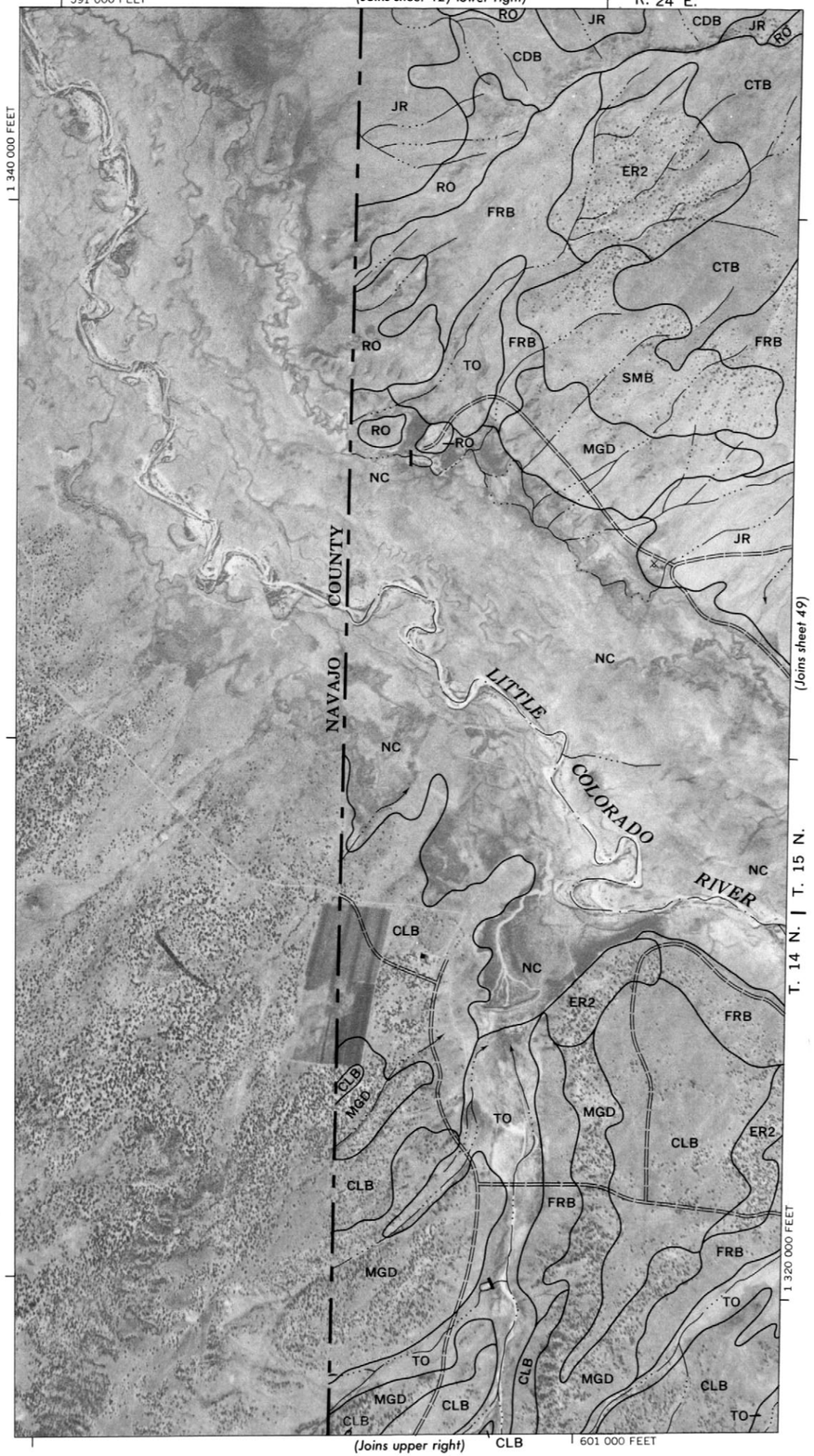
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

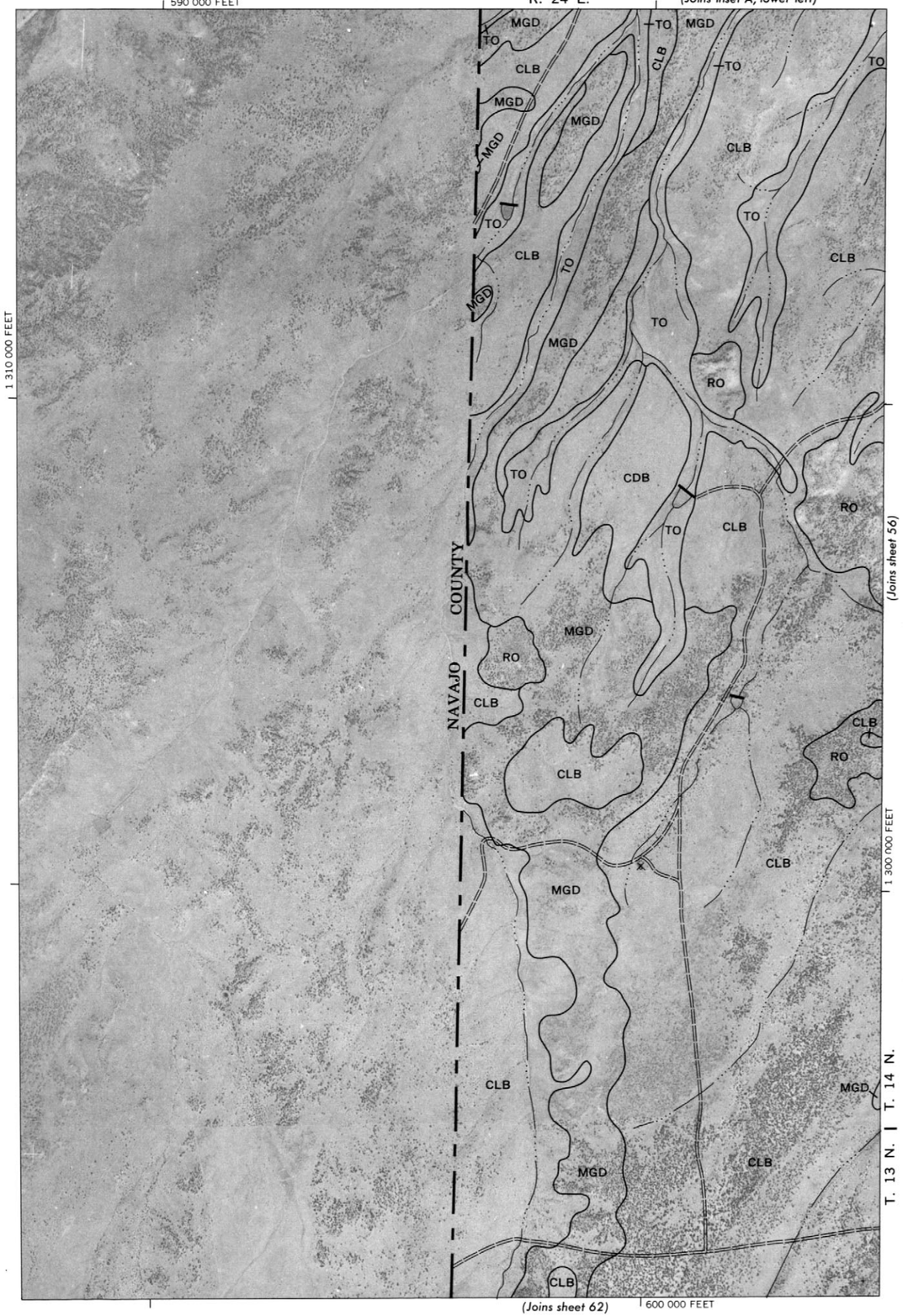
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 55

INSET A





55

N

3 Miles 2 1 0 15 000 10 000 5 000 0 Feet

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

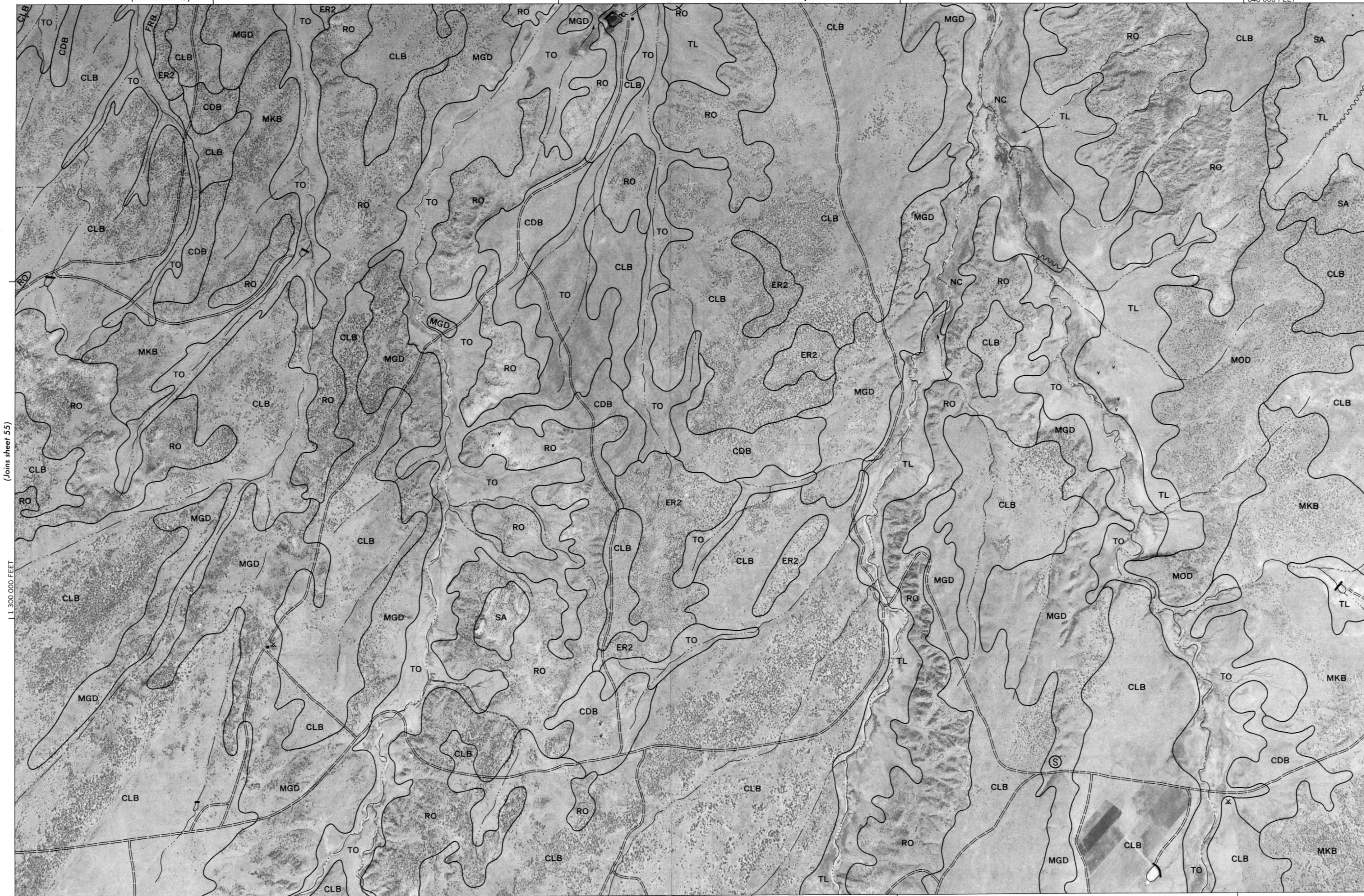
CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 56

N

Scale 1:31 680

3 Miles — 2 — 1 — 0 — ¼ — ½ — ¾ — 1

15 000 Feet — 10 000 — 5 000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 57

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 58

(Joins sheet 51)

N

Scale 1:31 680

3 Miles 2 1 0 ¼ ½ ¾ 1

15000 Feet 10000 5000 0 1000 2000 3000 4000 5000

(Joins sheet 57)

(Joins sheet 59)

(Joins sheet 65)

R. 26 E. | R. 27 E.

T. 13 N. | T. 14 N.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 59

59

N

R. 27 E. | R. 28 E.

730 000 FEET

(Joins sheet 52)

R. 28 E. | R. 29 E.

1 310 000 FEET

T. 13 N. | T. 14 N.

(Joins sheet 58)

(Joins sheet 60)

1 300 000 FEET

760 000 FEET

(Joins sheet 66)

Carrizo Wash

LITTLE COLORADO RIVER

water

21 22
28 27

30 29
31 32

61

666

HUC2

FRB CLB MGD NC TO RO SA NdA CDB BA JR ER2 LO TrA TrB TmC CsC CcC CoB NaB NaC

3 Miles
2
1
0
15 000 Feet
10 000
5 000
0
1 000
2 000
3 000
4 000
5 000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 60

(60)

N

R. 29 E. | R. 30 E. | 790 000 FEET

(Joins sheet 53)

Carrizo Wash

TO NC CTB ER2 LO CLB FRB JR RO HUC2 SMB BA CDB MGD TV

(Joins sheet 59)

(Joins sheet 67)

(Joins sheet 61)

T. 13 N. | T. 14 N.

1 310 000 FEET

1 300 000 FEET

760 000 FEET

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

1/4 1/2 3/8 0 1000 2000 3000 4000 5000 6

1 6 / 12 7

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 61

61

N

800 000 FEET

(Joins sheet 54)

1 310 000 FEET

(Joins sheet 60)

T. 13 N. | T. 14 N.

R. 30 E. | R. 31 E.

(Joins sheet 68)

830 000 FEET

1 300 000 FEET

CATRON COUNTY NEW MEXICO

VALENCIA COUNTY NEW MEXICO

26 25
35 36

25 30
36 31

CTB CLB ER2 LO RO SA JR TO NC HUB2

3 Miles
2
1
15 000 Feet
10 000
5 000
0
1/4
1/2
3/4
1
1000
2000
3000
4000
5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

62

N

Scale 1:31 680

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

¼ ½ ¾ 1

1000 2000 3000 4000 5000

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 62

INSET A

R. 24 E.

605 000 FEET

600 000 FEET

T. 12 N.

T. 13 N.

1 260 000 FEET

1 290 000 FEET

1 250 000 FEET

1 270 000 FEET

595 000 FEET

590 000 FEET

NAVAJO COUNTY

(Joins lower right)

(Joins sheet 69)

(Joins sheet 55)

(Joins sheet 63)

(Joins sheet 75)

(Joins inset A, upper left)

MKB MOD RO TO NC HUC2 SU TDB CLB MGD WFB SA

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 63

63

N

610 000 FEET

1 290 000 FEET

(Joins sheet 56)

(Joins sheet 62)

(Joins sheet 64)

(Joins sheet 69)

1 270 000 FEET

640 000 FEET

T. 13 N.

R. 24 E. | R. 25 E.

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

(Joins sheet 57)

680 000 FEET

1 290 000 FEET

(Joins sheet 63)

(Joins sheet 65)

1 270 000 FEET

(Joins sheet 70)

650 000 FEET

R. 25 E. | R. 26 E.

T. 13 N.

N

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

Scale 1:31 680

1 680 1 000 2 000 3 000 4 000 5 000

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 65

65

690 000 FEET

1 290 000 FEET

(Joins sheet 58)

(Joins sheet 64)

(Joins sheet 66)

(Joins sheet 71)

720 000 FEET

1 270 000 FEET

T. 13 N.

R. 26 E. | R. 27 E.

N

3 Miles

15000 Feet

10 000

5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

BLACK RIDGE

UNDERGROUND CABLE

CANAL

intermittent

8 | 9
17 | 16

23 | 24
26 | 25

180 61

66

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 66

R. 27 E. | R. 28 E. (Joins sheet 59) | R. 28 E. | R. 29 E.

730 000 FEET

1 290 000 FEET

N

3 Miles 15 000 Feet 10 000

Scale 1:31 680

5000 1 5000

(Joins sheet 65)

(Joins sheet 72)

(Joins sheet 67)

1 270 000 FEET

760 000 FEET

T. 12 N. | T. 13 N.

Sanders Airport

Apache County Fairgrounds

St Johns

LITTLE COLORADO RIVER

LYMAN CANAL

UNDERGROUND CABLE

G P

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 67

67

760 000 FEET

1 290 000 FEET

R. 29 E. | R. 30 E.

(Joins sheet 60)

(Joins sheet 66)

(Joins sheet 68)

(Joins sheet 73)

800 000 FEET

T. 12 N. | T. 13 N.

1 270 000 FEET

N

Carrizo Wash

3 Miles

15 000 Feet

10 000

5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

68

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 68

(Joins sheet 61)

(Joins sheet 67)

(Joins sheet 74)

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

¼ 0 1000 2000 3000 4000 5000

½ ¾ 1

830 000 FEET

1 290 000 FEET

1 270 000 FEET

800 000 FEET

T. 13 N.

T. 12 N.

R. 30 E. | R. 31 E.

NEW MEXICO

CATRON COUNTY

Carrizo Wash

13 | 18
24 | 19

UNDERGROUND CABLE

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 69

69

N

610 000 FEET

1 260 000 FEET

T. 12 N. | T. 13 N.

R. 24 E. | R. 25 E.

1 250 000 FEET

640 000 FEET

(Joins inset A, sheet 62)

(Joins sheet 63)

(Joins sheet 70)

(Joins sheet 76)

Mesa Redonda

MKB MOD TO SA RO NC SU CDB TL TDB RXB CLB SRB HUB

3 Miles 2 1 0 15 000 Feet 10 000 5 000

Scale 1:31 680

1 ¼ ½ ¾ 1 0 1 000 2 000 3 000 4 000 5 000

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

(Joins sheet 64)

680 000 FEET

T. 12 N. | T. 13 N.

1 260 000 FEET

N

3 Miles 2 1

15 000 Feet 10 000 5 000

Scale 1:31 680

1 250 000 FEET

(Joins sheet 69)

(Joins sheet 71)

(Joins sheet 77)

650 000 FEET

R. 25 E. | R. 26 E.

Concho

Concho Lake

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 71

71

N

T. 12 N. | T. 13 N.

690 000 FEET

1 260 000 FEET

(Joins sheet 65)

(Joins sheet 70)

(Joins sheet 72)

(Joins sheet 78)

720 000 FEET

1 250 000 FEET

R. 26 E. | R. 27 E.

19 | 20
30 | 29

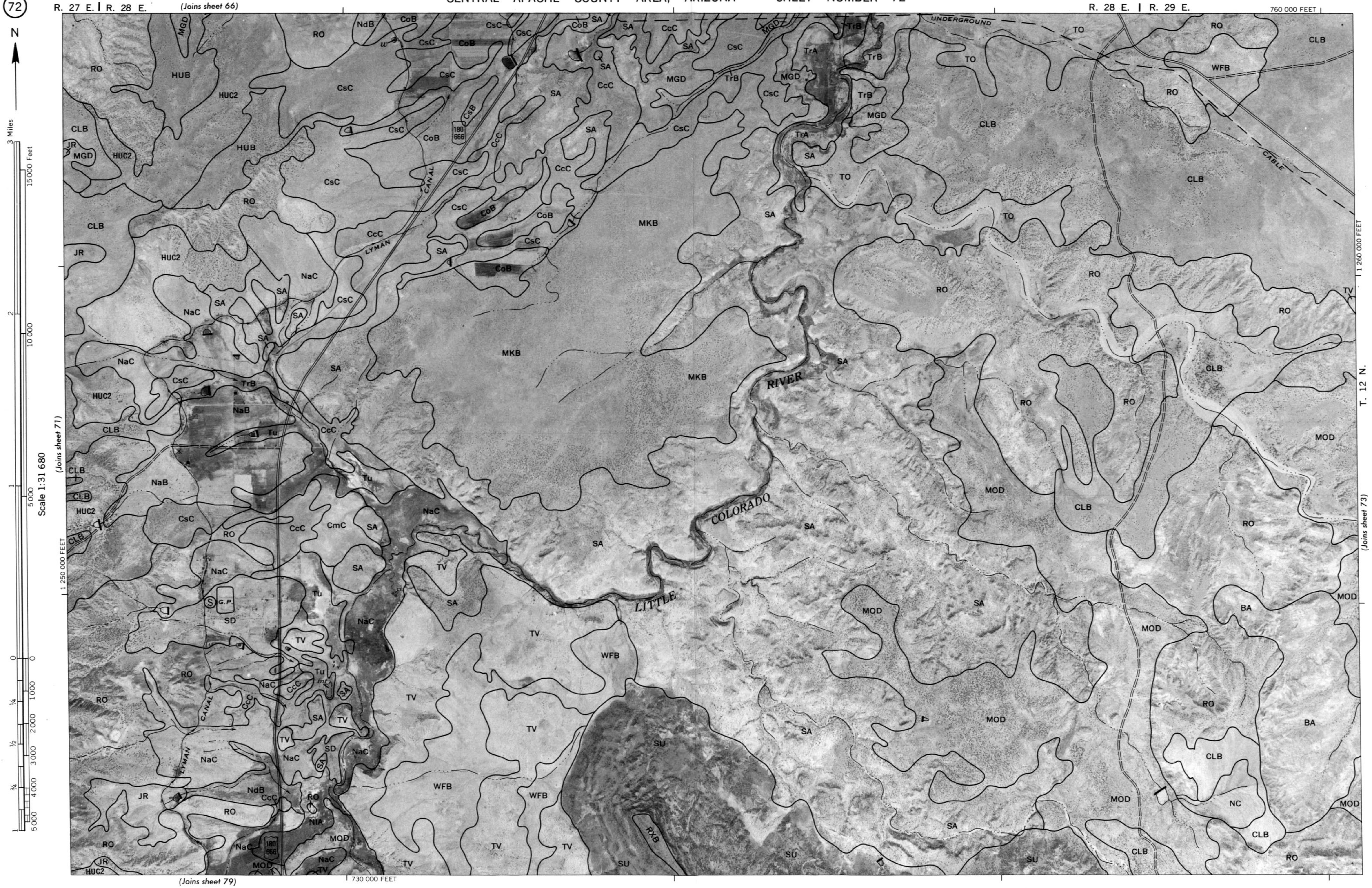
HUB RXB WFB TDB SU CLB RO MGD TO TrB JR CDB NC HUC2 NaC int

3 Miles
2
1
0
¼
½
¾
1
15 000 Feet
10 000
5 000
0
1 000
2 000
3 000
4 000
5 000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 72



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 73

73

N

770 000 FEET

(Joins sheet 67)

R. 29 E. | R. 30 E.

T. 12 N.

1 260 000 FEET

1 250 000 FEET

(Joins sheet 72)

(Joins sheet 74)

(Joins sheet 80)

800 000 FEET

UNDERGROUND

CABLE

17 | 16
20 | 21

CLB TV SA RO WFB MOD JR SU RXB HUC2 NT HUB BA

3 Miles 15 000 Feet 10 000 5 000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

74

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 74

(Joins sheet 68)

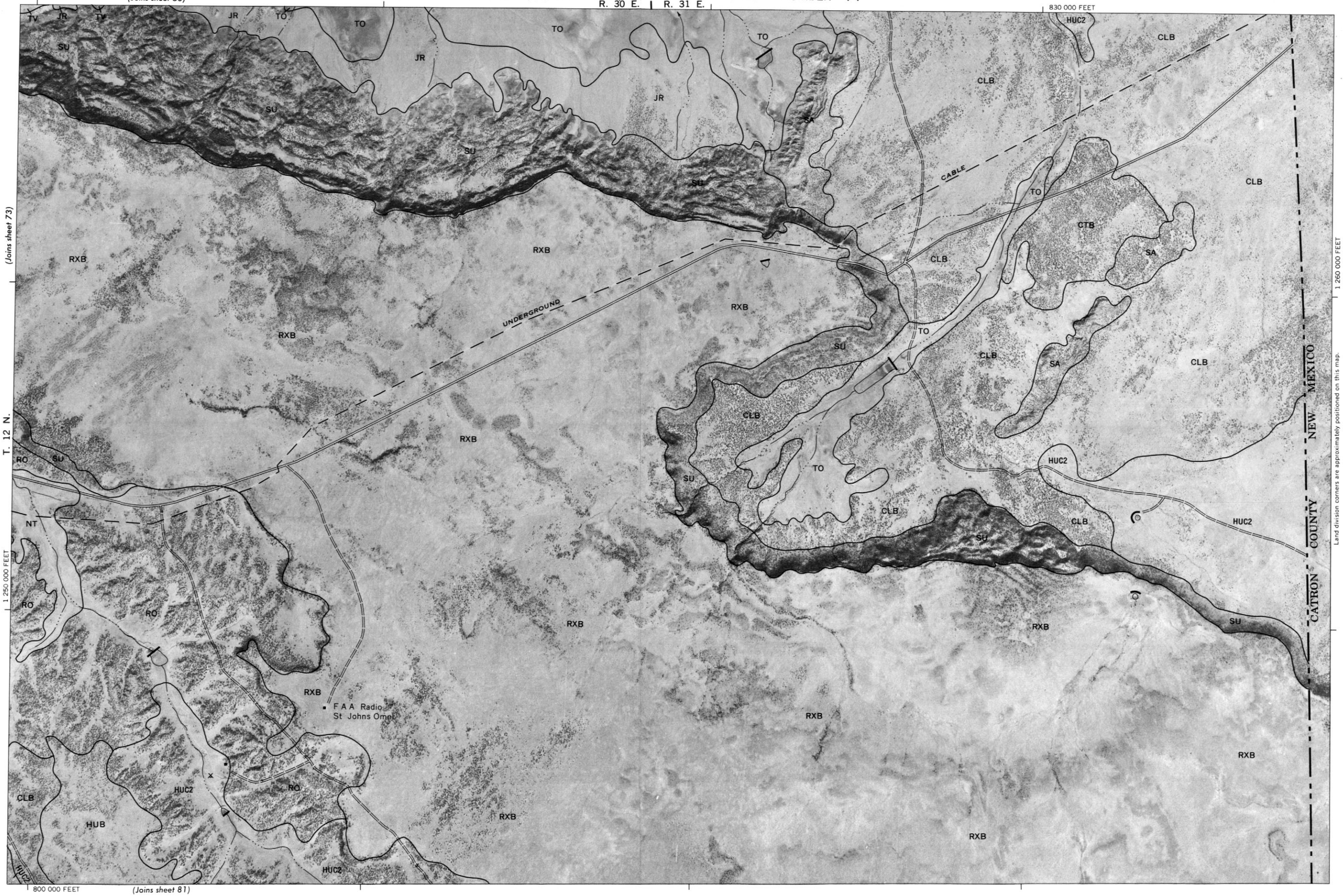
R. 30 E. | R. 31 E.

830 000 FEET

(Joins sheet 73)

T. 12 N.

1 250 000 FEET



1 260 000 FEET

800 000 FEET

(Joins sheet 81)

N

Scale 1:31 680

3 Miles 2 1 0

15000 Feet 10000 5000 0

1 ¼ ½ ¾ 1

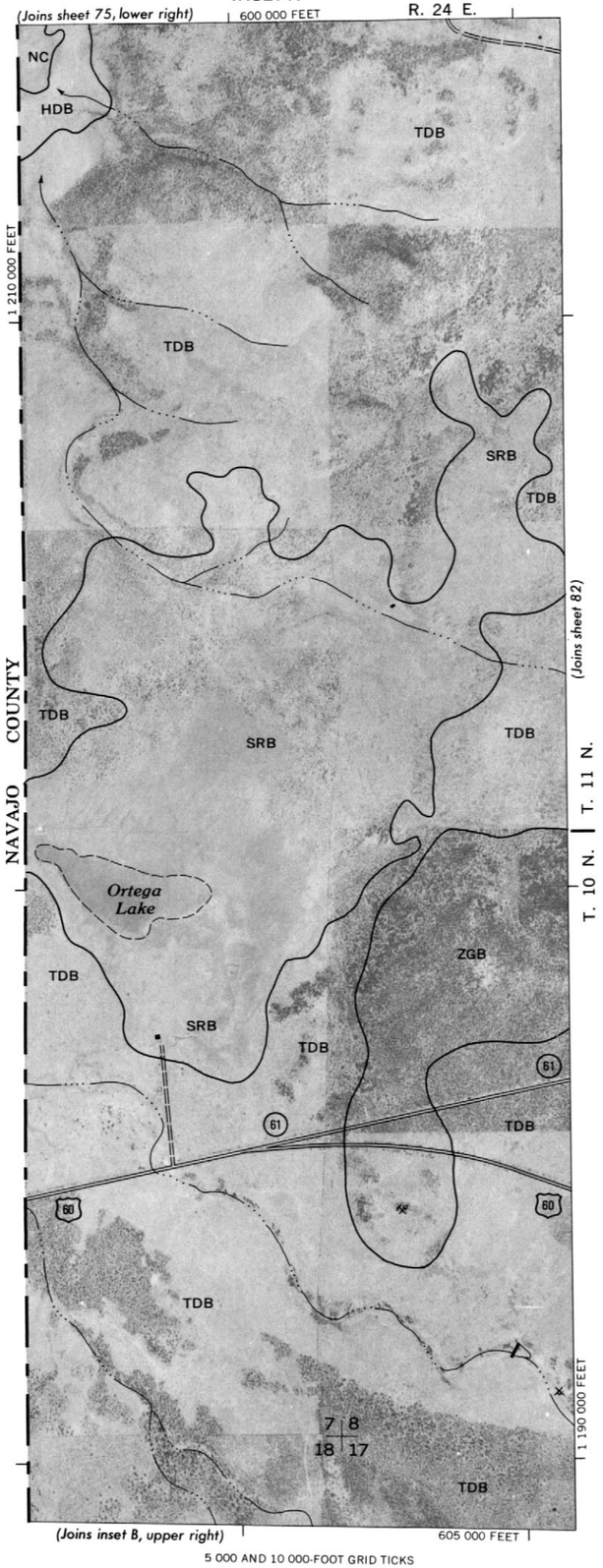
5000 4000 3000 2000 1000 0

Land division corners are approximately positioned on this map.

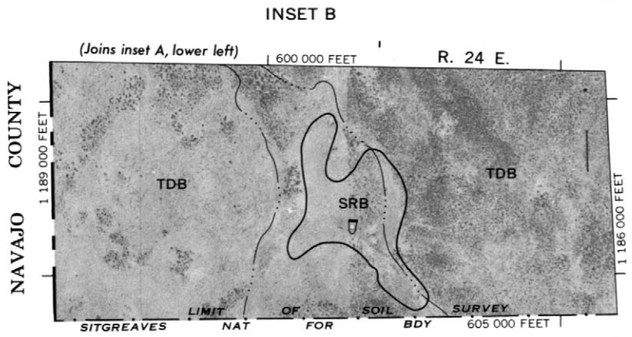
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

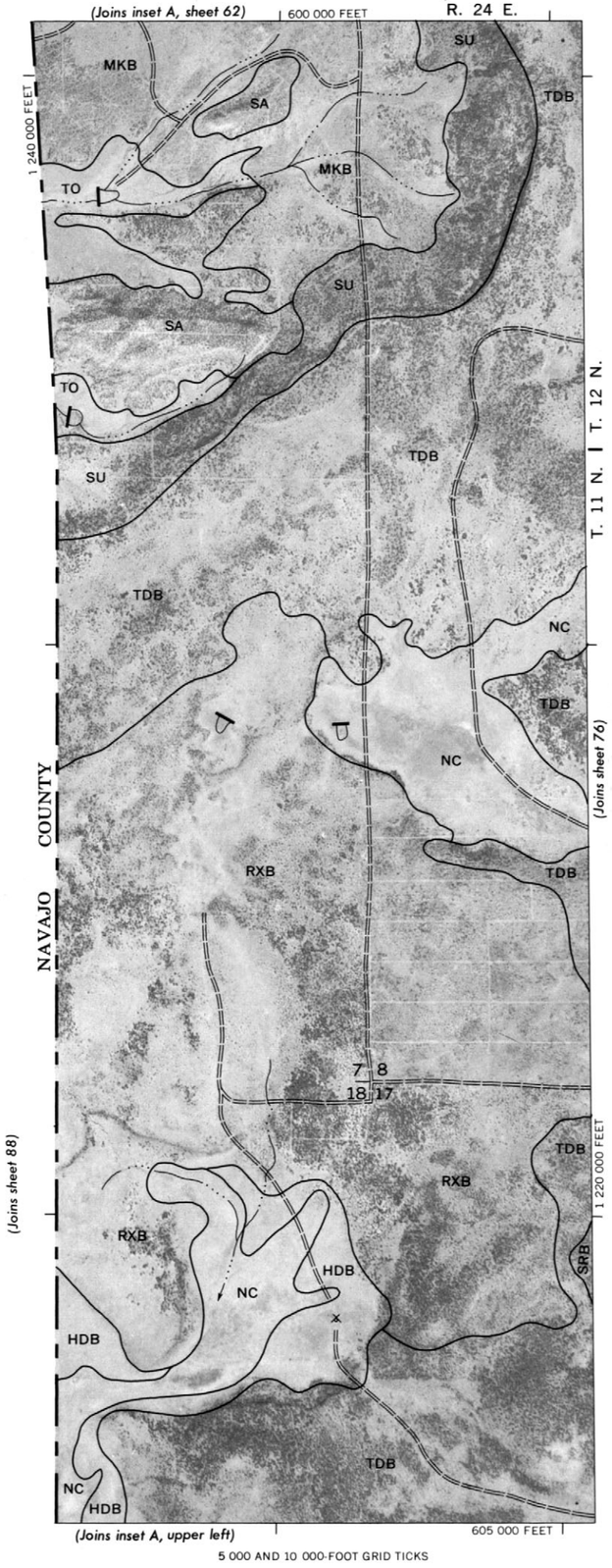
CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 75



5 000 AND 10 000-FOOT GRID TICKS



3 000 AND 5 000-FOOT GRID TICKS



5 000 AND 10 000-FOOT GRID TICKS

75

N

3 Miles 2 1 0 15 000 Feet 10 000 5 000 0

1 ¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

76

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 76

N

Scale 1:31 680

3 Miles 2 1 0 15000 Feet 10000 5000 0

½ 0 ¼ 0 ¾ 1000 2000 3000 4000 5000

(Joins sheet 69)

R. 24 E. | R. 25 E.

640 000 FEET

1 240 000 FEET

T. 11 N. | T. 12 N.

1 220 000 FEET

610 000 FEET

(Joins sheet 75)

(Joins sheet 77)

(Joins sheet 82)

TDB SU SA MKB NC RXB SRB HUB TO HDB JR CLB int intermittent

33 34 4 3

10 11 15 14

61

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 77

650 000 FEET

R. 25 E. | R. 26 E.

(Joins sheet 70)

77

N

1 240 000 FEET

T. 11 N. | T. 12 N.

(Joins sheet 76)

(Joins sheet 78)

1 220 000 FEET

(Joins sheet 83)

680 000 FEET

3 Miles

15000 Feet

10 000

5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

SU RXB TO RO int HDB CE SRB CLB intermittent water BDE HUB TDB ZGB 33 4 3 Creek Mineral

78

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 78

R. 26 E. | R. 27 E.

(Joins sheet 71)

720 000 FEET

1 240 000 FEET

T. 11 N. | T. 12 N.

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

1 ¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

1 220 000 FEET

690 000 FEET

(Joins sheet 77)

(Joins sheet 79)

(Joins sheet 84)

SU CLB RO NC HUB JR TO CE RXB BDE TDB HDB HUC2

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 79

79

N

730 000 FEET

1 240 000 FEET

T. 11 N. | T. 12 N.

(Joins sheet 72)

(Joins sheet 78)

(Joins sheet 80)

(Joins sheet 85)

R. 27 E. | R. 28 E.

R. 28 E. | R. 29 E.

760 000 FEET

1 220 000 FEET

LITTLE COLORADO RIVER

LYMAN CANAL

LYMAN RESERVOIR

Little Colorado R.

180
666

RO
NaC
NIA
MOD
TV
JR
WFB
SU
SA
RXB
CLB
TO
HUB
HUC2
Tu
CDB

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Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

3 Miles
2
15 000 Feet
10 000
5000
0
1
5000
1000
2000
3000
4000
1/4
1/2
3/4

Scale 1:31 680

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 80

(80)

N

3 Miles 2 1

15 000 Feet 10 000 5 000

Scale 1:31 680

1 ½ 0

¼ 0

1000 2000 3000 4000 5000

1 ¾ ½ ¼ 0

(Joins sheet 73)

R. 29 E. | R. 30 E.

800 000 FEET

1 240 000 FEET

T. 11 N | T. 12 N.

1 220 000 FEET

(Joins sheet 79)

(Joins sheet 81)

(Joins sheet 86)

770 000 FEET

MOD RO CLB WFB HUC2 HUB SA TO RXB

26 25 35 36

30 29 31 32

2 1 11 12

17 16 20 21

8 9 17 16

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 80

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 81

81

(Joins sheet 74)

800 000 FEET

1 240 000 FEET

R. 30 E. | R. 31 E.

T. 11 N. | T. 12 N.

32 | 33
5 | 4

10 | 11
15 | 14

NEW MEXICO — ARIZONA

CATRON COUNTY

HUB HUC2 CLB RXB RO

(Joins sheet 80)

(Joins sheet 87)

830 000 FEET

1 220 000 FEET

N

Scale 1:31 680

3 Miles 2 1 0 1

15000 Feet 10 000 5000 0

¼ ½ ¾ 1

1000 2000 3000 4000 5000

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

(82)

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 82

N

3 Miles — 15 000 Feet — 10 000 — 5 000

Scale 1:31 680

(Joins sheet 76)

R. 24 E. | R. 25 E.

640 000 FEET

1 210 000 FEET

(Joins inset A, sheet 75)

(Joins sheet 83)

1 680

1 190 000 FEET

610 000 FEET

(Joins sheet 88)

T. 11 N.

T. 10 N.

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 83

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

(Joins sheet 82)

650 000 FEET

R. 25 E. | R. 26 E.

(Joins sheet 77)

1 210 000 FEET

T. 11 N.

T. 10 N.

Intermittent

Mineral Creek

Mineral Creek

Creek

water

G.P.

1 6
12 7

(Joins sheet 84)

(Joins sheet 89)

680 000 FEET

1 190 000 FEET

Scale 1:31 680

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

5 000 4 000 3 000 2 000 1 000 0

¾ ½ ¼ 0

83

N

84

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 84

N

Scale 1:31 680

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

1/4 1/2 3/4 1 0 1000 2000 3000 4000 5000

(Joins sheet 78)

(Joins sheet 83)

(Joins sheet 85)

(Joins sheet 90)

720 000 FEET

1 210 000 FEET

1 190 000 FEET

690 000 FEET

R. 26 E. | R. 27 E.

T. 10 N. | T. 11 N.

RXB TDB HDB BDE

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 85

R. 27 E. | R. 28 E.

730 000 FEET

(Joins sheet 79)

R. 28 E. | R. 29 E.

N

1 210 000 FEET

T. 11 N.

T. 10 N.

1 200 000 FEET

(Joins sheet 84)

(Joins sheet 86)

(Joins sheet 91)

760 000 FEET

RXB — TV — CDB — SU — SA — MOD — HUB — HUC2 — SD — CLB — TO — RO — JR — SU — Sh — HDB — BEB

int

Little Colorado River

Coyote Creek

23 24 26 25

180 666

3 Miles 2 1 0

15 000 Feet 10 000 5000 0

¾ ½ ¼ 0

5000 4000 3000 2000 1000 0

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

N

Scale 1:31 680

3 Miles 2 1 0 15000 Feet 10 000 5000 0

5 000 4 000 3 000 2 000 1 000 0

1 200 000 FEET

800 000 FEET

1 210 000 FEET

770 000 FEET

(Joins sheet 80)

(Joins sheet 85)

(Joins sheet 87)

(Joins sheet 92)

R. 29 E. | R. 30 E.

T. 11 N.

T. 10 N.

SU RXB CLB HUB TO WFB RO HUC2 CDB NT

Coyote Creek

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 87

87

N

800 000 FEET

1 210 000 FEET

(Joins sheet 86)

(Joins sheet 81)

1 200 000 FEET

830 000 FEET

(Joins sheet 93)

R. 31 E. | R. 30 E.

T. 10 N. | T. 11 N.

NEW MEXICO

CATRON COUNTY

28 | 27
33 | 34

11 | 12
14 | 13

HUB HUC2 CLB RXB SU NT

3 Miles

15 000 Feet

10 000

5 000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 88

88

N

Scale 1:31 680

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

1 5 000 | ¾ 4000 | ½ 3000 | ¼ 2000 | 0 1000 | 0

(Joins sheet 82)

R. 24 E. | R. 25 E.

640 000 FEET

1 185 000 FEET

(Joins inset B, sheet 75)

610 000 FEET

LIMIT OF SITGREAVES NATIONAL FOREST SURVEY BDY

TDB SRB ZGB ZGE Sp TbC CgB ZeC int G.P.

13 18 19

Vernon

21 22 28 27 33

T. 10 N.

(Joins sheet 89)

INSET A

(Joins sheet 94)

R. 27 E.

720 000 FEET

1 135 000 FEET

T. 8 N. | T. 9 N.

APACHE NATIONAL FOREST BDY

SURVEY

SOIL LIMIT OF

34 2 11 14

BDE TDB

1 125 000 FEET

710 000 FEET

(Joins sheet 98)

73

APACHE NATIONAL FOREST BDY LIMIT OF SOIL SURVEY

1 165 000 FEET

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

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CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 89

89

650 000 FEET

(Joins sheet 83)

1 185 000 FEET

T. 10 N.

(Joins sheet 88)

CnC G.P. CgB SRB TbC BDE TDB

Mineral Creek

APACHE NATIONAL FOREST BDY

LIMIT OF APACHE NATIONAL FOREST SOIL SURVEY BDY

(Joins sheet 90)

1 165 000 FEET

R. 25 E. | R. 26 E.

680 000 FEET

N

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

Scale 1:31 680

5 000 4 000 3 000 2 000 1 000 0

¾ ½ ¼ 0

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Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 90

(90)

N

3 Miles 2 1 0

15 000 Feet 10 000 5 000 0

Scale 1:31 680

1 000 2 000 3 000 4 000 5 000 Feet

¼ ½ ¾ 1

(Joins sheet 84)

720 000 FEET

1 185 000 FEET

(Joins sheet 89)

(Joins sheet 91)

1 165 000 FEET

690 000 FEET

R. 26 E. | R. 27 E.

(Joins sheet 94)

T. 9 N. | T. 10 N.

TDB BDE RXB ZGB BDB

60

LIMIT OF APACHE NATIONAL FOREST SOIL SURVEY BDY

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 91

91

N

R. 27 E. | R. 28 E.

730 000 FEET

(Joins sheet 85)

R. 28 E. | R. 29 E.

1 185 000 FEET

T. 9 N. | T. 10 N.

(Joins sheet 90)

(Joins sheet 92)

1 165 000 FEET

(Joins sheet 95)

760 000 FEET

RXB
HUB
TV
BEB
SU
BDB
BDE
HDB
SRB
ZGB
CE
int
intermittent
Little Colorado River
180
666
60
33 | 34
4 | 3

3 Miles
15 000 Feet
10 000
5 000
0
1/4
1/2
3/4
1
2
1000
2000
3000
4000
5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

92

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 92

N

(Joins sheet 86)

R. 29 E. | R. 30 E.

800 000 FEET

1 185 000 FEET

(Joins sheet 91)

(Joins sheet 93)

1 165 000 FEET

770 000 FEET

(Joins sheet 96)

T. 9 N. | T. 10 N.

3 Miles 15 000 Feet 2 10 000 1 5 000

Scale 1:31 680

1 5 000 ¾ 4 000 ½ 3 000 ¼ 2 000 0 1 000 0

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

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CENTRAL APACHE COUNTY AREA, ARIZONA NO. 92

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 93

93

N

800 000 FEET

R. 30 E. | R. 31 E.

(Joins sheet 87)

1 185 000 FEET

T. 9 N. | T. 10 N.

25 | 30
36 | 31

1 175 000 FEET

830 000 FEET

(Joins sheet 92)

(Joins sheet 97)

CATRON COUNTY — NEW MEXICO

HUB RXB SU RO TL CDB MGD HUC2 CLB

3 Miles
2
1
0
15000 Feet
10 000
5000
0
¼
½
¾
1
1000
2000
3000
4000
5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

94

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 94

(Joins sheet 90)

R. 27 E.

720 000 FEET

1 160 000 FEET

T. 9 N.

(Joins sheet 95)

(Joins inset A, sheet 88)

T. 7 N.

1 140 000 FEET

1 100 000 FEET

1 000 000 FEET

690 000 FEET

715 000 FEET

N

3 Miles

15 000 Feet

10 000

5 000

Scale 1:31 680

5 000 AND 10 000-FOOT GRID TICKS

APACHE NATIONAL FOREST BOY SURVEY

APACHE NATIONAL FOREST BOY SOIL SURVEY

APACHE NATIONAL FOREST BOY SOIL SURVEY OF APACHE NATIONAL FOREST LIMIT

TDB

BDE

BsE

CgB

CaD

LuB

CaC

SD

int

17 16 21

CE

INSET A

R. 27 E.

720 000 FEET

1 100 000 FEET

T. 7 N.

1 000 000 FEET

715 000 FEET

Greer

Colorado River

Little Colorado River

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.
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CENTRAL APACHE COUNTY AREA, ARIZONA NO. 94

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 95

95

R. 27 E. | R. 28 E. | 730 000 FEET | R. 28 E. | R. 29 E. | (Joins sheet 91)

N

1 160 000 FEET

T. 9 N.

(Joins sheet 94)

(Joins sheet 96)

1 140 000 FEET

(Joins sheet 98)

760 000 FEET

RXB — CE — TDB — BDE — NT — SU — Sh — EaC — HfB — EgC

12 | 7
13 | 18

14 | 13
23 | 24

33
4 | 3

Little Colorado River

Becker Lake

SPRINGERVILLE - EAGER AIRPORT

180
666

60

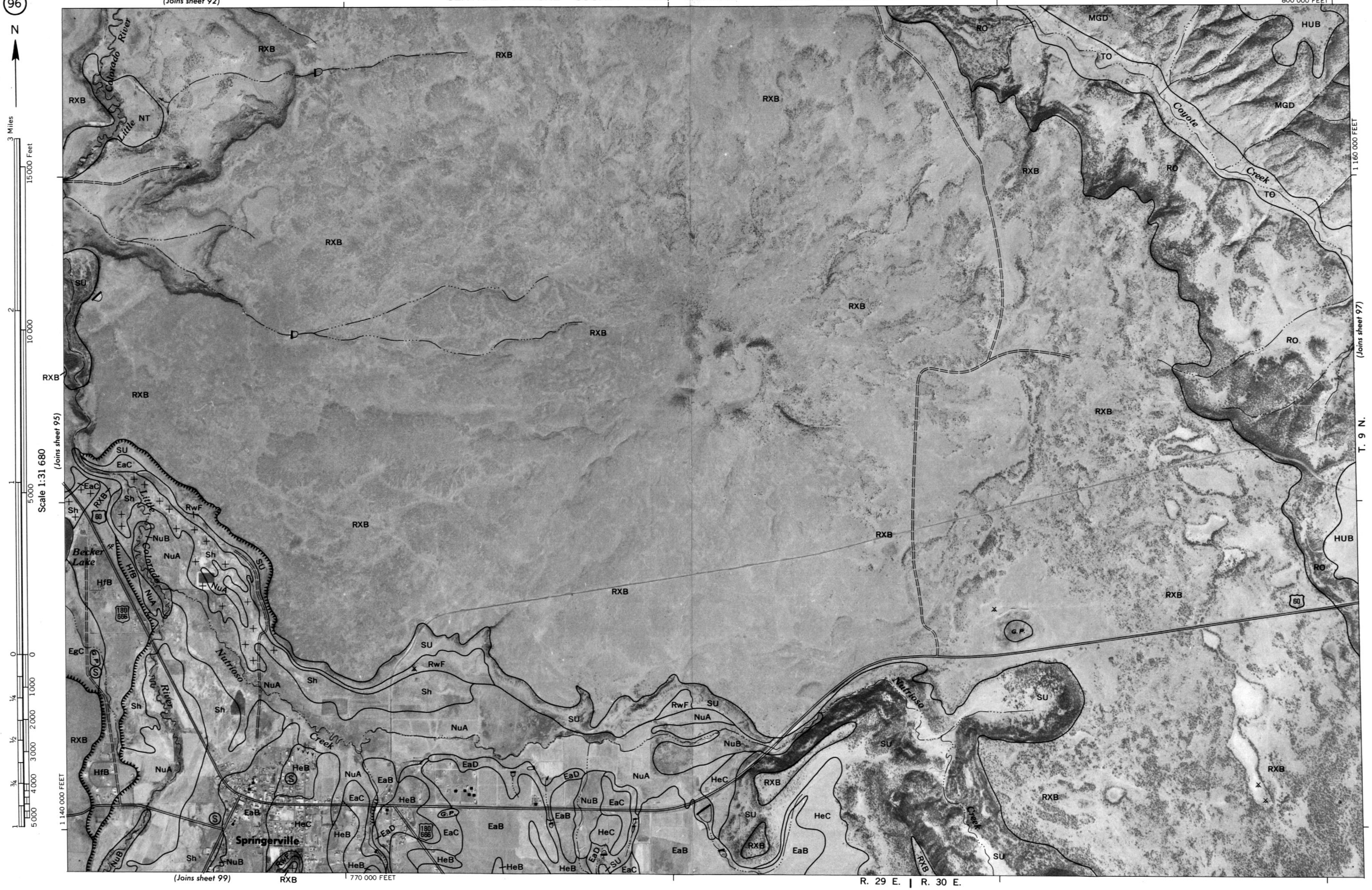
S

3 Miles
2
1
0
15 000 Feet
10 000
5 000
0
¼
½
¾
1
1000
2000
3000
4000
5000

Scale 1:31 680

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 96



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 97

97

800 000 FEET

(Joins sheet 93)

1 160 000 FEET

(Joins sheet 96)

T. 9 N.

Coyote Creek

Coyote Creek

15 14
22 23

60

CATRON COUNTY NEW MEXICO

R. 30 E. | R. 31 E.

830 000 FEET

(Joins inset A, sheet 99)

1 140 000 FEET

N

3 Miles

15 000 Feet

10 000

5000

Scale 1:31 680

5000 4000 3000 2000 1000 0

¾ ½ ¼ 0

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

98

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 98

R. 27 E. | R. 28 E. (Joins sheet 95) R. 28 E. | R. 29 E. 760 000 FEET

T. 8 N. | T. 9 N.

1 135 000 FEET

(Joins inset A, sheet 88)

(Joins inset B, sheet 99) (Joins sheet 99 upper left)

1 115 000 FEET

730 000 FEET

5 000 AND 10 000 FOOT GRID TICKS

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000

¾ ½ ¼ 0 5000 4000 3000 2000 1000 0

SPRINGERVILLE-EAGER AIRPORT

Little Colorado River

LIMIT OF APACHE NATIONAL FOREST SOIL SURVEY BDY

TDB BDE RXB NT SU NuB NuA HeB HeC EaB EaC EaD FuC RwF

8 9
17 16

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

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CENTRAL APACHE COUNTY AREA, ARIZONA — NO. 98

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 99

99

N

R. 29 E. | R. 30 E.

T. 8 N. | T. 9 N.

770 000 FEET

1 135 000 FEET

(Joins sheet 98)

(Joins sheet 96)

(Joins lower left)

5 000 AND 10 000 FOOT GRID TICKS

1 130 000 FEET

800 000 FEET

(Joins inset B)

LIMIT OF APACHE NATIONAL FOREST SOIL SURVEY BDY

Eager

Little Colorado River

Sh, EaB, EaC, EaD, EaE, HeB, HeC, HfB, FuC, RwF, NuA, NuB, RXB, SU

4 3 2 1 5 6 7 8 9 10 11 12

73

180 666

R. 30 E. | R. 31 E.

INSET A

(Joins sheet 97)

810 000 FEET

1 138 000 FEET

(Joins upper right)

RXB, RO, HUC2, HUB, SA, TO, CLB, NT, SU

35 36 1 2 3 4 5 6 7 8 9 10 11 12

Chinle Creek

CATRON COUNTY NEW MEXICO

1 128 000 FEET

830 000 FEET

5 000-FOOT GRID TICKS

(Joins upper left)

INSET B

762 000 FEET

R. 29 E.

1 128 000 FEET

(Joins sheet 98)

T. 8 N.

NuB, EaB, FuC, HeB, EaD, RwF, SU

1 123 000 FEET

767 000 FEET

APACHE NAT FOR BDY

Scale 1:31 680

3 Miles

15 000 Feet

10 000

5 000

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Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 100

100

N

Scale 1:31 680

3 Miles 2 1 0 15 000 Feet 10 000 5 000 0

1 ¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

800 000 FEET

1 110 000 FEET

1 090 000 FEET

770 000 FEET

T. 7 N. | T. 8 N.

R. 29 E. | R. 30 E.

(Joins sheet 101)

A P A C H E N A T I O N A L F O R E S T

Rudd Creek

Nutrioso Creek

SURVEY LIMIT OF SOIL

SU HrC BsE NuB NuC HhB RwF BuC CaC CgD EaE EaB EgC FuC HeC HeB LuB

666 180

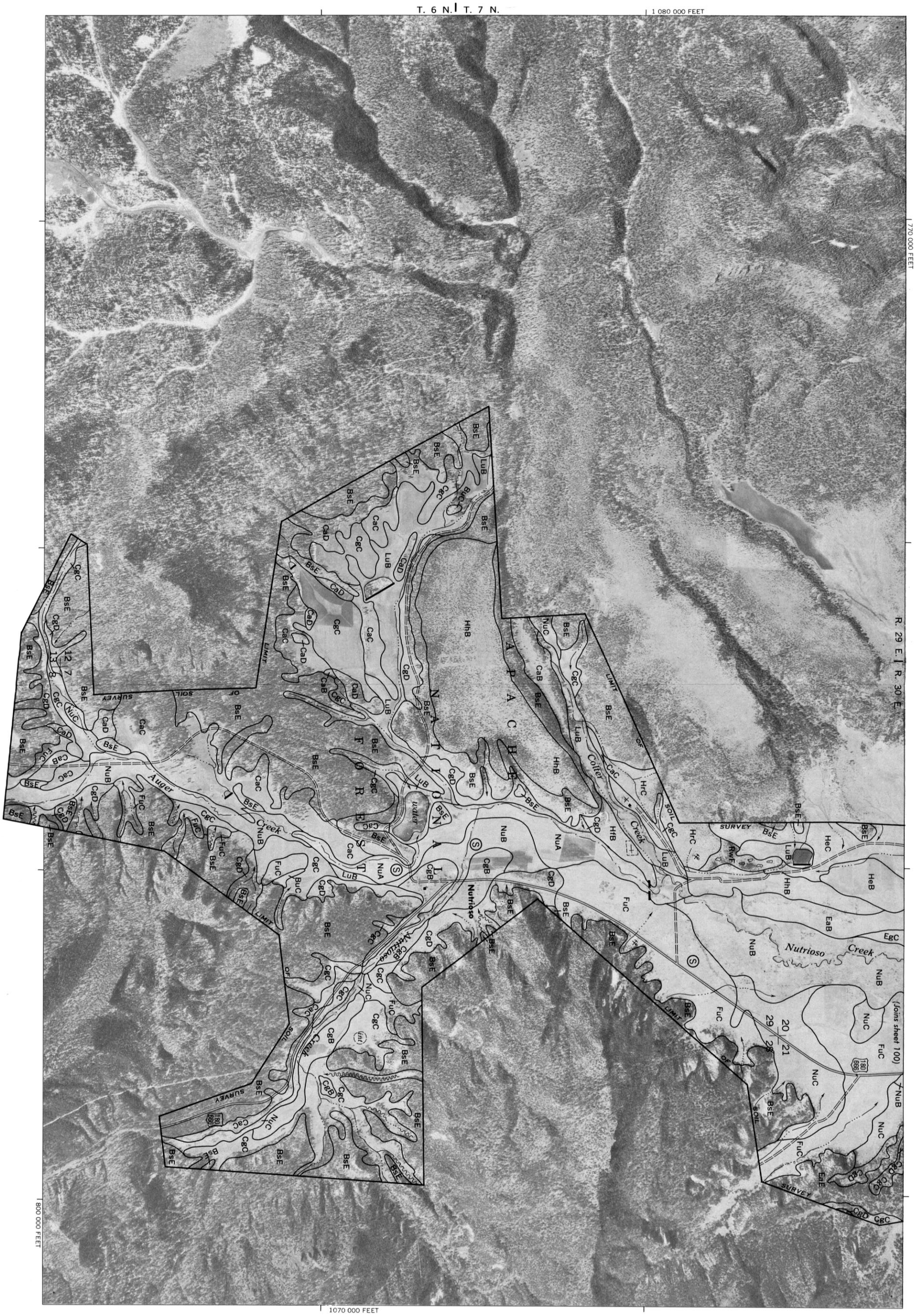
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone, 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA NO. 100

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 101



1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10 000 15 000 Feet

Scale 1:31 680

N

101

CENTRAL APACHE COUNTY AREA, ARIZONA — SHEET NUMBER 102

102

N

Scale 1:31 680

3 Miles 2 1 0

15000 Feet 10 000 5 000 0

1/4 1/2 3/4 1

1000 2000 3000 4000 5000

(Joins inset A)

R. 30 E. | R. 31 E.

840 000 FEET

1 040 000 FEET

1 020 000 FEET

T. 5 N.

Alpine

San Francisco River

Luna Lake

F O R E S T

A P A C H E

N A T I O N A L

(Joins inset B)

810 000 FEET

INSET A

R. 30 E.

805 000 FEET

1 045 000 FEET

1 040 000 FEET

T. 5 N. | T. 6 N.

(Joins upper left)

800 000 FEET

5 000-FOOT GRID TICKS

INSET B

(Joins lower right)

R. 31 E.

840 000 FEET

1 040 000 FEET

1 018 000 FEET

1 013 000 FEET

T. 5 N.

835 000 FEET

5 000-FOOT GRID TICKS

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Arizona coordinate system, east zone. 1927 North American datum.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Arizona Agricultural Experiment Station.

CENTRAL APACHE COUNTY AREA, ARIZONA NO. 102